University of Southampton

Faculty of Environmental and Life Sciences

School of Psychology

Synthesis Of Qualitative Research on Post-Stroke Fatigue and Cognitive Behavioural Therapy for Post Brain Injury Fatigue: A Single Case Experimental Design

by

Alexandros Zouloumis

Thesis for the degree of Doctor in Clinical Psychology

May, 2024

University of Southampton

Abstract

Faculty of Environmental and Life Sciences
School of Psychology

Doctor of Clinical Psychology

Synthesis Of Qualitative Research on Post-Stroke Fatigue and Cognitive Behavioural Therapy for Post Brain Injury Fatigue: A Single Case Experimental Design

By

Alexandros Zouloumis

This thesis synthesised qualitative experiences of post-stroke fatigue in stroke survivors and explored the effectiveness of cognitive behaviour therapy interventions for the management of post brain injury fatigue.

The first chapter includes a systematic review reporting qualitative experiences of post stroke fatigue. Studies frequently reported on the distinct nature of post stroke fatigue and its life changing consequences. Moreover, studies often conveyed the experience of living and functioning with post-stroke fatigue and strategies that contribute to its management.

The second chapter includes an empirical paper reporting on the effectiveness of a cognitive behavioural therapy intervention for people with post brain injury fatigue using a withdrawal/reversal single case experimental design. This intervention was safe and well accepted by participants (*n* = 4) with post brain injury fatigue. It was effective at reducing fatigue levels as all participants reported significant reliable change in their fatigue complaints. For all participants fatigue reduction was observed during the intervention after the formulation/psychoeducation session of the intervention. Therefore, formulation and psychoeducation, even when used briefly, can result in improved outcomes for people with post brain injury fatigue. All participants' fatigue levels remained low throughout the intervention and at follow-up indicating cognitive behavioural therapy to be an effective therapeutic approach.

Table of Contents

Table of Tables

Table of Figures

List of Appendices

Research Thesis: Declaration of Authorship

Print name: Alexandros Zouloumis

Title of thesis: Synthesis of Qualitative Research on Post-Stroke Fatigue and Cognitive Behavioural Therapy for Post Brain Injury Fatigue: A Single Case Experimental Design

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signature: Date: 14th May 2024

Acknowledgements

First, I would like to thank the four participants who took part in the intervention. I am extremely grateful for your participation. Thank you for trusting the process and agreeing to take part in a clinical trial. I feel privileged to have listened to your personal experiences and struggles with brain injury and post-brain injury fatigue. Seeing your rehabilitation progress over time, made me feel inspired to carry on working in the field of clinical neuropsychology.

I would like to thank my academic supervisor, Dr Warren Dunger for his continuous support and guidance throughout my thesis. Your mentorship and encouragement helped me persevere even at times when things were not going according to plan. Your positive attitude, academic and clinical expertise were invaluable to the success of my thesis.

I would like to thank Juan Mertel Morillo, my second academic supervisor and CBT expert. Having regular CBT supervision with you, allowed me to develop my CBT competences and feel more confident in the delivery of CBT therapy. Thank you for listening to my therapy tapes and for ensuring treatment fidelity was met.

I want to thank my clinical supervisor, Professor Birgit Gurr for trusting me and sharing her knowledge and expertise with me for the last three years. Being able to offer an intervention for ABI patients experiencing post-brain injury fatigue would not be possible without her.

I am incredibly grateful to my mum Kaiti, for our endless conversations over my thesis journey. Most importantly, I thank her for the emotional and practical support over the years and for always believing in me.

I want to thank my lovely family in Greece and Germany. Although we are geographically far away from each other, your support and love has been always there for me.

Finally, yet importantly, I want to thank Fr Petros Zois for his continuous and multifaceted support throughout the years.

Definitions and Abbreviations

ACT	Acceptance and Commitment Therapy
ABI	Acquired Brain Injury
ADL	Activities of Daily Life
ACC	Anterior Cingulate Cortex
CASP	Critical Appraisal Skills Programme
CBT	Cognitive Behavioural Therapy
CTS-R	Cognitive Therapy Scale-Revised
FSS	Fatigue Severity Scale
GAD	Generalised Anxiety Disorder
HE	Health Education
MFIS	Modified Fatigue Inventory Scale
NAP	Non-overlap All Pairs
NHS	National Health System
PBIF	Post Brain Injury Fatigue
PHQ	Patient Health Questionnaire
PSF	Post-Stroke Fatigue
PTH	Post Traumatic Hypopituitarism
SCED	Single Case Experimental Design
SF36	Short Form 36
SPIDER	Sample, Phenomenon of Interest, Design, Evaluation, Research
TAU	Treatment as usual
VA-F	Visual Analogue Severity of Fatigue
WAI-SR	Working Alliance Inventory-Short Revised

Chapter 1 Synthesis of Qualitative Research on Post-Stroke Fatigue

This chapter is written as a manuscript excluding the formal title page, for the Journal of Neuropsychological Rehabilitation (see Appendix A for author guidelines).

1.1 Abstract

The purpose of this systematic review was to synthesise qualitative research on the first-hand experiences of post stroke fatigue (PSF) in stroke survivors. Four electronic databases were searched, including PsycINFO, CINAHL, MEDLINE, and Web of Science, to identify peer reviewed literature published between 2012 and 2024. Eleven studies were identified. A thematic synthesis approach led to the development of four analytical themes: “Not the fatigue you may already know”, “A life-changing experience”, “Living with PSF” and “What helps lessen PSF”. Findings provide in-depth descriptions of PSF, insights into this life-changing experience, how stroke survivors function with PSF and what helped them to manage with the condition. This research highlights the complex phenomenon of PSF and the need for acknowledging its presence among stroke survivors to ameliorate its impact and equip them with the right tools to be prepared to handle this post-stroke symptom. Clinical implications and directions for future research are discussed.

1.1.1 Keywords

Stroke, Fatigue, Qualitative Research, Interviews, Lived Experience, Thematic Synthesis

1.1.2 Main Text Count

Excluding tables and figures the word count is 9,304.

1.2 Introduction

Stroke

Stroke is a life-threatening neurological condition characterised by interruption of blood flow to the brain caused by blocked or ruptured arteries (Kuriakose & Xiao, 2020). There are three main pathologic types of strokes; ischemic stroke, intracerebral haemorrhage, and subarachnoid haemorrhage (Price et al., 2018).

Stroke is the second most common cause of death and the leading cause of disability in Europe (Saka et al., 2008). In the UK, over 113,000 stroke incidents take place a year with around 1 million stroke survivors nationally (King et al., 2020). Researchers predict that stroke incidence in the UK will increase by 60% per year between 2015 and 2035 with stroke prevalence projected to increase by 120% between 2015 and 2035 (King et al., 2020). Therefore, it is important that health services address the consequences of stroke (Chaplin, 2023).

Post Stroke Fatigue

Post-stroke fatigue (PSF) is one of the most common and frustrating outcomes of stroke with debilitating consequences (Aali et al., 2020). Up to 40% of stroke survivors report PSF as the worst or one of their most debilitating symptoms (Paciaroni & Acciarresi, 2019). Frequency of PSF among stroke survivors ranges from 29% to 77% (Van Der Werf et al., 2001), and it is generally accepted that PSF affects 1 in 2 people after stroke (Cumming et al., 2016). In a more recent systematic review regarding the prevalence of PSF, findings suggest that PSF affects 25% to 85% of patients with stroke around the world (Alghamdi et al., 2021).

PSF impacts stroke survivors' engagement with medication and rehabilitation programmes, impacts their quality of life, and interferes with participation in daily activities (Lerdal & Gay, 2017). PSF is considered the greatest barrier of good rehabilitation outcomes in stroke survivors as it reduces the likelihood of going back to work (Andersen et al., 2011) and is linked with higher risk of institutionalisation (Mead et al., 2011). PSF is also an important predictor for death after the onset of stroke (Glader et al., 2002). Furthermore, due to the multifaceted and long-term consequences of stroke, family members and caregivers may undergo many emotional, psychological, and physical changes themselves, which can impact their daily lives (Schlemmer, 2023).

There is still limited knowledge as to why PSF happens and which treatments can be effective (Eriksson et al., 2022). Despite its prevalence, there is currently little evidence about what ameliorates PSF and insufficient research regarding the personal strategies for its management (Alahmari et al., 2023). Although several comprehensive reviews have been conducted to identify ways to manage PSF (Kennedy & Kidd, 2018; Wu et al., 2015), clear conclusions are yet to be made due to difficulties with defining PSF, but also limitations in study' designs. This has led to poor clinical guidelines which rely heavily on healthcare professionals' perspectives, rather than on those who have the lived experience (Ablewhite et al., 2022).

Definitions of PSF

PSF has been described as "*a feeling of early exhaustion with weariness, lack of energy and aversion to effort that develops during physical or mental activity and is usually not ameliorated by rest*" (Staub & Bogousslavsky 2001). PSF is a multidimensional motor-perceptive, emotional, and cognitive experience and due to its subjective nature, has only recently attracted researchers' interest (Acciarresi et al., 2014). Due to its heterogeneous clinical presentation, inherent subjectivity, and complex biopsychosocial elements, PSF is hard to define, characterise and measure (Hinkle et al., 2017). There is currently no consensus in the literature about PSF's definition and there is no effective way to measure and manage it (Aaronson et al., 1999). Moreover, there are no evidence-based strategies for prevention and treatment (Askari et al., 2023).

Due to the lack of consensus on the experience of PSF, qualitative research has been helpful as this is driven by the patient's experience. Although attempts have been made to attain a better understanding of PSF through qualitative studies, these attempts were mainly focused on the severity of fatigue and its impact, rather than the nature of PSF (Young et al., 2013). A limited number of studies have explored stroke survivors' experiences and perceptions of PSF (Tremayne et al., 2020) as well as the day-to day problems experienced by stroke survivors (Worthington et al., 2017).

In a meta-synthesis of 12 qualitative studies exploring stroke survivors' experiences of PSF, there were only four studies which explicitly mentioned PSF in the study's aims (Eilertsen et al., 2012). Researchers' meta-synthesis identified five core characteristics of PSF, which were: a lack of energy to perform activities, an abnormal need for long-lasting sleep, getting easily tired by activity, unpredictable feelings of fatigue without explanation, and increased stress sensitivity. However, as further research on this topic has been conducted since this review, there is a need for an updated synthesis of the literature to better understand this complex phenomenon.

Current systematic review

In addition to the meta-synthesis from Eilertsen et al. (2012), Whitehead et al.'s (2016) systematic review compared experiences of fatigue across long-term conditions, including stroke. It is notable however, that although more papers were published between 2013 and 2016, their review included 11 research papers in its analysis as opposed to 12 used by Eilertsen et al. (2012). Moreover, although researchers found different patterns in the experience of fatigue between cancer related and PSF, these differences were not explicitly outlined in detail and further research on the experience of fatigue across a wide range of conditions was deemed necessary by the researchers. For the reasons outlined above, the aim of this review is to capture all relevant, recent, published qualitative literature since the publication of the systematic review conducted by Eilertsen et al. (2012) to further contribute to the understanding of PSF.

Using a thematic synthesis approach, the current systematic review aims to explore the first-hand experiences and perceptions of PSF in stroke survivors to enhance our conceptualisation of PSF and draw conclusions which can inform clinical practice (Boland et al., 2017). This will involve identifying relevant qualitative research, which typically addresses questions relating to developing an understanding of a certain concept (Fossey et al., 2002).

As PSF remains an ongoing priority for international research and the fourth top priority for stroke rehabilitation and long-term care in the UK, more research in this area is critical (Norrving et al., 2018). Research can lead to the development of better-informed clinical guidelines relying more on stroke survivors' lived experience of PSF, enhance clinicians' understanding of PSF and its consequences, identify more effective coping strategies for patients, and inform clinical practice.

1.3 Materials and Methods

The current systematic review was conducted and presented following the guidance of the 'Preferred Reporting Items for Systematic Reviews and Meta-analyses' (PRISMA, Page et al., 2021). The systematic review was registered with the 'International Prospective Register of Systematic Reviews' (PROSPERO), registration number: CRD42024476102.

1.3.1 Search strategy

To develop the inclusion/exclusion criteria for this systematic review and decrease the risk of excluding relevant research studies, a "Sample", "Phenomenon of Interest", "Design", "Evaluation", "Research Type" (SPIDER) table was produced (Cooke et al., 2012). The search terms used for the SPIDER search can be seen in Table 1.

Four electronic databases were searched (including PsycINFO, CINAHL, MEDLINE, and Web of SCIENCE) to identify peer reviewed literature published between May 2012 and January 2024.

There were many reasons for choosing these databases to conduct this systematic review. Initial scoping searches identified previous systematic reviews in the same topic but also systematic reviews in similar topics. All these reviews either included all the above-mentioned databases or most of them. For example, Lerdal et al. (2009) conducted a review on post-stroke fatigue using four databases including CINAHL and PsycINFO. Similarly, a previous systematic review on the same topic conducted by Eilersten et al. (2012) included CINAHL and PsycINFO in their search. A more recent systematic review on the prevalence of fatigue after stroke conducted by Alghamdi et al. (2021) used seven databases including MEDLINE, PsycINFO, CINAHL and Web of Science. Furthermore, a review conducted by Paudel et al. (2023) on the prevalence and impact of post-stroke fatigue on patient outcomes in the first six months after stroke also included CINAHL and MEDLINE in their search. Therefore, we chose to use these four databases as they include relevant publications to the research question.

Librarians should be involved in methodological design of systematic reviews as this can result in greater variety of information sources (Vassar et al., 2017). After completing initial scoping searches, the main researcher met with a librarian to further discuss the research question and identify the most suitable databases to capture all relevant literature on the research topic. These conversations led to the selection of MEDLINE, CINAHL, PsycINFO and Web of Science as the most suitable databases to address the research question of this systematic review.

Additionally, the research team decided to include these four databases given the nature of the research question. MEDLINE and Web of Science broadly cover all sciences and medical topics in specific, PsycINFO covers literature relevant to cognitive therapies, while CINAHL covers nursing and other health related publications and is an excellent source for issues in patient care (Boland et al., 2017). For the reasons described above, the research team deemed the selection of these four databases appropriate for conducting the current systematic review.

A previous systematic review conducted on the same topic was published in 2012 including published research until April 2012 (Eilertsen et al., 2012). This systematic review therefore initiated its search from May 2012 to capture all published literature since the previous systematic review.

Table 1.1

The search terms used in PsycINFO, Medline and CINAHL for the SPIDER search

SPIDER Tool	Search terms
Sample	stroke* OR ischemic OR h?emorrhag* OR infarct* OR cerebrovascular
	AND
Phenomenon of Interest and Design	fatigue OR “chronic fatigue” OR exhaustion
	AND
Evaluation and Research Type	qualitative OR “personal experience*” OR interview* OR “lived experience*” OR perception*

1.3.2 Inclusion and exclusion criteria

The following inclusion/exclusion criteria were used to identify relevant literature.

Table 1.2

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
• participants over 18 years	• participants were under the age of 18
• participants diagnosed with a stroke (any type) and experiencing PSF	• studies that do not focus on patients' perception of PSF, but on other difficulties that follow a stroke
• peer reviewed qualitative studies between May 2012 and January 2024	• studies that focus on the perception/perspective of family members/support network/other professionals on stroke survivors' fatigue
• qualitative or mixed methods studies which focus on first-hand experiences of stroke survivors' fatigue and themes have been identified (focus will be only on qualitative analysis in mixed method studies)	• audio files, book, and conference proceedings or grey literature • secondary data reviews
• research published in English	• non-English literature

1.3.3 Search terms

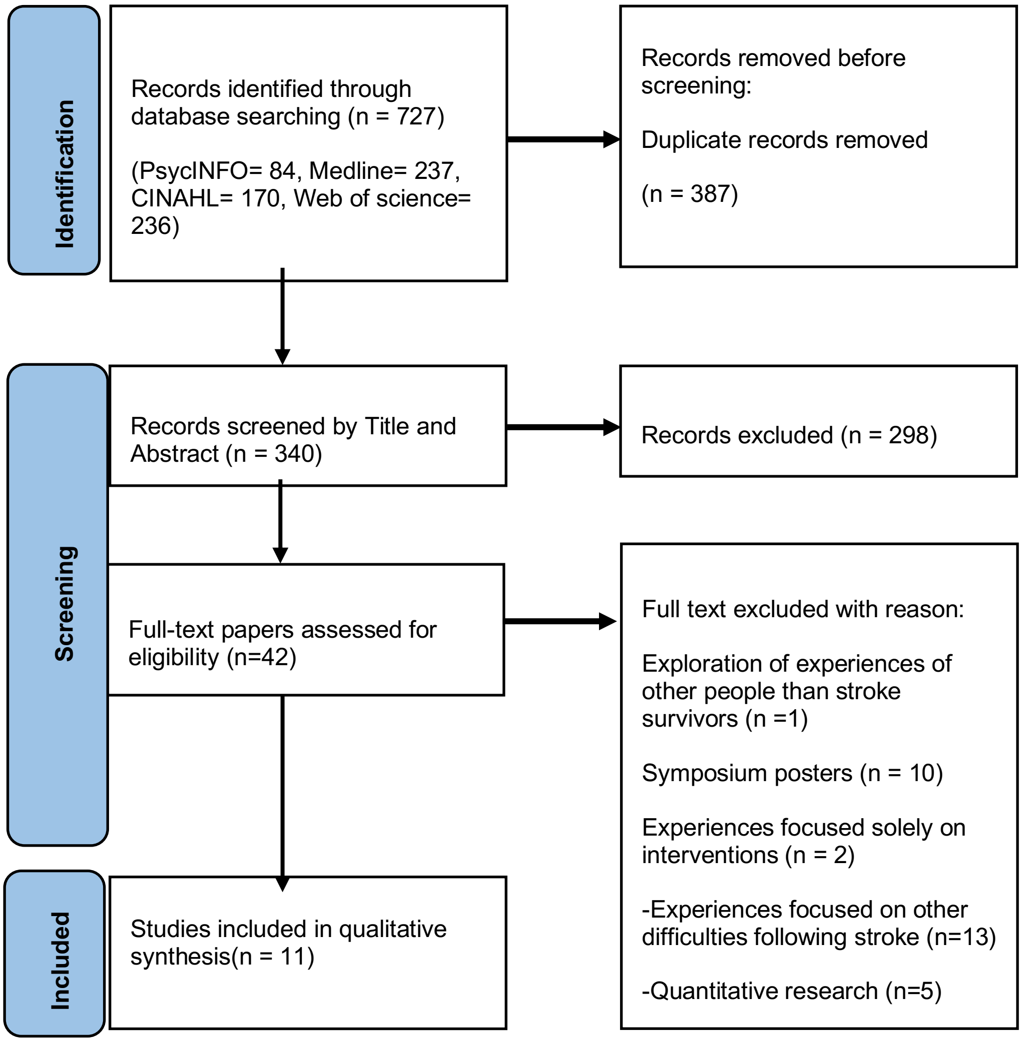
Search terms were initially identified through scoping searches and subsequently devised with the collaboration of a librarian. Search terms were amended as appropriate across databases. Search terms used in Web of Science can be found in Table 5 (see Appendix 1.9.2.). Subject terms were also used to expand the search further aiming to capture as many relevant papers as possible (see appendix 1.9.2., Tables 1.6, 1.7, and 1.8).

1.3.4 Screening process

A PRISMA (Page et al., 2021) flowchart (see Figure 1.1) presents the screening process which was followed in this systematic review. Initial search of databases identified 727 research papers. After removing duplicates, 340 papers were screened using the title and abstract. Through screening titles and abstracts, 298 papers were excluded. 43 papers were then full text screened. This process excluded 32 papers, identifying 11 papers which met the inclusion criteria of this systematic review. Systematic reviews should be characterised by transparency, replicability, and a clear inclusion criterion (Belur et al., 2018). To check for inter-rater reliability and preclude subjectivity, screening was conducted independently by the first researcher and a third-year trainee clinical psychologist. There was a 100% agreement between the two examiners in the screening process.

Figure 1.1

PRISMA (Page et al., 2021) Flow Diagram



1.3.5 Quality assessment

Following screening, all identified papers were critically appraised with the use of the Critical Appraisal Skills Programme Qualitative Checklist (CASP, 2018). The CASP tool is the most frequently used tool to appraise strengths and weaknesses of qualitative research (Long et al., 2020). Moreover, the CASP checklist is a user-friendly tool for a novice qualitative researcher and is endorsed by Cochrane and the World Health Organisation for use in qualitative evidence synthesis (Hannes & Macaitis, 2012). The CASP checklist consists of 10 questions which guide researchers to rate the quality of research papers and decide whether to include them or not in a systematic review. All questions, apart from question 10, in the CASP checklist can be answered by choosing “Yes”, “No”, or “Can’t tell”. The CASP tool does not include instructions around the response choices. Researchers, therefore, decided to choose the option “Yes”, when a clear answer for the question could be found, answer “No”, when no information was given for the relevant question, and the option “Can’t tell”, when there was insufficient information to make a judgment. The final question of the CASP checklist *“How valuable is this research”* was not used in the appraisal as reviewers need to rely on their subjective judgement to answer this question, and this may affect inter-rater reliability (Maeda et al., 2022). The CASP checklist does not suggest a scoring system but advise that evidence may be of poor quality if the reader cannot confidently answer the first two/three questions of the CASP checklist. To overcome this and rate the quality of the papers included in this review, researchers decided to use the sum of the number of times “Yes” was used as the answer to the CASP checklist’s questions (Hofmeister et al., 2018). If the answer “Yes” was reported 1-3 times the quality of the paper was categorized as low quality, if “Yes” was reported 4-6 times the quality was rated as unclear/moderate quality, and if “Yes” was reported 7-9 times the quality was categorized as high quality.

Ratings for all included papers were conducted by the main researcher. The second researcher independently rated 20% (n=3) of the included research and there was a 100% consensus on all responses.

1.3.6 Data extraction

Only the main researcher extracted data from the 11 identified papers, but this was discussed with the other researchers. Following data extraction, the following information was extracted: author(s) and year of publication, country, method of qualitative data collection, sample and how participants were recruited, type of data analysis, and the key findings.

1.3.7 Methods of qualitative analysis

Qualitative research is defined as “the study of the nature of phenomena” and is used to answer questions about the experience, meaning and perspective, most often from the standpoint of the participant (Hammarberg et al., 2016). Each method of qualitative data analysis is guided by different theoretical principles. An inductive reasoning approach for example enables the discovery of new patterns and relationships through an iterative process of analysing data while a contextual understanding approach puts more emphasis on the importance of understanding the context in which research takes place.

1.3.8 Data synthesis in this systematic review

A thematic synthesis approach was used to analyse data in this systematic review (Thomas & Harden, 2008). Thematic synthesis is an adaptation to typical qualitative methods as it is for the purpose of secondary data synthesis of ‘thematic analysis’ and other qualitative approaches.

Thematic synthesis is a method of qualitative evidence synthesis (QES). QES is a type of systematic review that brings together findings from primary qualitative research in a systematic way, aiming to establish a greater understanding of issues which are frequently addressed in primary qualitative research (Flemming & Noyes, 2021). The findings of a QES can provide rich interpretations in relation to the impact of a condition and can enable a deeper understanding of individuals’ and groups’ experiences and perceptions of a certain condition. By synthesising evidence from primary qualitative research, this process enables the development of new cumulative knowledge. Using a QES method, researchers can go beyond the findings of individual studies and produce something greater than the sum of the individual parts (Carroll, 2017). QES can also help increase readers’ understanding of a specific phenomenon.

There are numerous different methods that can be used to undertake a QES (Booth et al., 2012). Three of the most developed methods for QES are thematic synthesis, framework synthesis, and meta-ethnography. Each type of these methods provides a unique approach to QES and has advantages and disadvantages.

Thematic synthesis methodology was used over framework synthesis. Although a highly structured approach to QES, framework synthesis, is a deductive method aiming to interpret and integrate primary qualitative research within a particular context with the use of an a priori framework (Flemming et al., 2019). This type of analysis would therefore be more suitable for applied policy or clinical questions within a specific setting and would not allow for the flexibility that thematic synthesis offers in interpreting data.

We used thematic synthesis over meta-ethnography as this is primarily an interpretive synthesis method which goes beyond the findings of the individual primary studies synthesised, and does not simply aggregate findings (France et al., 2019). It is therefore a very complex method and synthesis process that requires a highly experienced team. Given the limited experience of the main researcher in conducting a systematic review, a thematic synthesis approach was deemed more appropriate for this systematic review.

Thematic synthesis is a method that is commonly used to analyse data in primary qualitative research. It is one of the most developed qualitative synthesis approaches and one of the most accessible and flexible forms of synthesis (Thomas & Harden, 2008). Thematic synthesis identifies the recurring themes or issues from multiple qualitative studies, interprets and explains these themes, and draws conclusions in systematic reviews (Cruzes & Dyba 2011). Thematic synthesis is an interpretative approach which goes further than thematic analysis methods and enables new insights, explanations, and theories to be developed (Flemming & Noyes, 2021). Following an inductive approach to coding, thematic synthesis allows the incorporation of both “thin” and/or “thick” data in the development of analytical themes. Furthermore, thematic synthesis is often used by novice researchers as it is a straightforward approach which prescribes a structured and organised way of analysing data and developing analytical themes. The research team therefore deemed this method to be appropriate to answer the research question of this systematic review.

Thematic synthesis involves the systematic coding of qualitative evidence to generate higher-order analytical themes (Nicholson et al., 2016). There are three steps in this approach (Nicholson et al., 2016). Initially, findings from qualitative research are collected and entered word-to-word into a database and each line of text is coded according to meaning and content. Following this, descriptive themes are developed by grouping the codes based on similarities and differences among them. Finally, analytical themes, which go beyond the content of the original papers, are developed (Graham et al., 2018).

Thomas and Harden (2008) have described thematic synthesis in stages, outlining the steps for its conduct. Adhering to this, the main researcher read the final 11 studies included in this systematic review multiple times to familiarise himself with the findings. With the use of NVivo (QSR International Pty Ltd, 2020), results and findings relating to qualitative data were extracted and coded line-by-line to generate ‘descriptive themes’. Following this, descriptive themes were reviewed with the wider research team, and this subsequently led to the development of ‘analytical themes’.

1.3.9 Researcher reflexivity

Epistemology influences implementation of methodology and the relationship between researcher and samples (Carter & Little, 2007). It is therefore important to acknowledge the epistemological approach of the researcher in the implementation of this systematic review. A 'critical realism' philosophical viewpoint was taken in this review, which assumes that the "observable world" is interpreted through every individual's subjective experience (Vincent & O'Mahoney, 2018). As all qualitative research is contextual, researchers should describe the contextual intersecting relationships between themselves and the studies' participants (Dodgson, 2019). By doing so, researchers increase the credibly of their findings and deepen readers' understanding of their work (Dodgson, 2019). All researchers had prior clinical experience in supporting stroke survivors and PSF. Although this may have been beneficial, it was important to acknowledge potential biases and assumptions researchers may bring due to their professional roles. Intersectionality is a key methodological aspect for critical research (Mountian, 2017). Two of the researchers in the team were male and one female. One researcher came from a Mediterranean culture and the other two were White British. Only one of the researchers had personal experience of PSF in their families.

1.4 Results

1.4.1 Quality assessment

The CASP tool was used to critically appraise all 11 research papers. All studies were rated 'high', however the relationship between researchers and participants was reported inconsistently (see Table 1.3).

1.4.2 Study and participant characteristics

The final synthesis included 11 papers (Alahmari et al., 2023, Alenljung et al., 2018, Askari et al., 2023, Christiansen et al., 2020, Connolly & Mahoney, 2018, Eriksson et al., 2022 and Kristensen et al., 2014, Pedersen et al., 2019, Tremayne et al., 2020, Young et al., 2013, Worthington et al., 2017). Details of each study from the data extraction phase are included in Table 4. Research papers were published between 2014 and 2023, and were conducted across multiple countries including Denmark, Sweden, USA, Saudi Arabia, Canada, and the UK. All studies used qualitative design with semi-structured interviews to collect data for their analysis. The overall number of participants was 141, of which 67 were female, 73 male, and one transgender male. All studies recruited participants who had sustained a stroke (both ischemic and haemorrhagic) and were experiencing post-stroke fatigue. Participants' age ranged from 18 to 83 years old with a median age of 53.68. Most participants were recruited from a western country (n=133) and only eight participants were recruited from an eastern country. Eight papers reported participants’ occupational status (n=110) of which 38 were in full-time or part-time employment, 50 participants had retired, five were unemployed, two were housewives, five were in work-training, five were volunteers and five were receiving financial help. Connolly and Mahoney (2018), Kristensen et al. (2014) and Young et al. (2013) do not provide participants’ occupational status. Only six papers reported participants’ marital status (Alahmari et al., 2023, Worthington et al., 2017, Tremayne et al., 2020, Pedersen et al., 2019, Askari et al., 2023, Alenljung et al., 2018). Of those participants (n=72), 19 were married, 34 were living with someone (partner, spouse, or a family member), three were divorced, one was living in a care unit, and 15 were living alone/single.

Table 1.2

Critical Appraisal Skills Programme (CASP, 2018) Ratings

Study number	Author and Year	Q1 Aim	Q2 Methodology	Q3 Research Design	Q4 Recruitment Strategy	Q5 Data Collection	Q6 Consideration of relationship between researcher and participant	Q7 Ethics	Q8 Data analysis	Q9 Findings
1.	Christiansen et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2.	Alahmari et al. (2023)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3.	Worthington et al. (2017)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes
4.	Tremayne et al. (2020)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes
5.	Pedersen et al. (2019)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes
6.	Young et al. (2013)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
7.	Askari et al. (2023)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes

Study number	Author and Year	Q1 Aim	Q2 Methodology	Q3 Research Design	Q4 Recruitment Strategy	Q5 Data Collection	Q6 Consideration of relationship between researcher and participant	Q7 Ethics	Q8 Data analysis	Q9 Findings
8.	Connolly & Mahoney (2018)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes
9.	Alenljung et al. (2018)	Yes	Yes	Yes	Yes	Yes	Can’t tell	Yes	Yes	Yes
10.	Eriksson et al. (2022)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
11.	Kristensen et al. (2014)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 1.3

Studies Details from Data Extraction Stage

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
1.	Christiansen et al., 2020 Denmark	To explore how patients with minor stroke experience the transitional period from hospital through the first 2-4 weeks after an accelerated care pathway with discharge within 72 hours after stroke onset.	The study used a descriptive, qualitative design with semi-structured interviews.	Sample: 11 participants (six females/ five males) were recruited from a highly specialised acute stroke unit in a Danish University Hospital. Current age of participants when recruited ranged from 47-75 years. Recruitment method: Purposive	Meaning condensation and hermeneutic meaning interpretation.	Four main themes were identified: 1. Shocked, yet grateful 2. everyday life is changed 3. managing uncertainty 4.how to regain daily life.
2.	Alahmari et al., 2023 Saudi Arabia	To explore how post-stroke survivors in Saudi Arabia experience and perceive PSF and its	The study used a qualitative descriptive design using semi-structure face to face interview approach.	Sample: 8 participants (four males and four females). Interviews were transcribed into	Inductive thematic analysis	Five main themes were identified: 1. Experience of post stroke fatigue.

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
		causes, hoe it impacts their daily life, their coping strategies, support from caregivers and doctors, and the management strategies.		Arabic by the main researcher and were then translated into English by the same researcher. Current age of participants ranged from 27-65 years. Recruited method: Purposive.		2. Perceived causes of post stroke fatigue 3. impact of post stroke fatigue on daily life activities. 4. strategies for coping with post stroke fatigue. 5. perceptions about support from caregivers and health care practitioners.
3.	Worthington et al., 2017 UK	The aim of the study was to explore the day-to-day fatigue related experiences and perspectives of participants who reported high levels of fatigue at six months following stroke.	The study used quality research methodology, using semi-structured interviews which were conducted at participants' home.	Sample: 22 participants (12 males and 10 females), primarily white British (20 British, two other), five in full/part time employment -17 retired/no longer walking, 17 living with spouse or another person -five living alone.	Thematic analysis.	Six themes were identified: 1. Diverse descriptions of post stroke fatigue 2. Daily impact of fatigue. 3. Factors found to exacerbate fatigue. 4. Self-management strategies for fatigue. 5. causes of fatigue. 6. Lack of information in advice received on fatigue.

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
				Current age of participants ranged from 51- 83 years. Recruitment method: Participants were identified from previous relevant study: Nottingham fatigue after stroke study (Drummond et al., 2017).		
4.	Tremayne et al., 2020 UK	The aim of the study was to understand post stroke fatigue, its impact, and the interventions that optimise stroke survivors' occupational engagement and mastery.	A general qualitative design was used. Data was collected by one-to-one, face-to-face semi structure interviews by the principal investigator who had training in qualitative interviewing.	Sample: 10 participants (six females and four 4 males), nine participants suffered an ischemic stroke and one, haemorrhagic stroke.	An inductive thematic analysis was used to provide a systematic and flexible method of data analysis	Three themes were identified and one overarching theme addressing the aims: 1. the individual and diverse nature of fatigue. 2. variability of stroke survivor experience of post stroke fatigue- education.

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
				Current age of participants ranged from 31-83 years. Recruitment method: Purposive sampling.		3. the role of stroke services. The overarching theme of acceptance and adaptation was present throughout the data.
5.	Pedersen et al., 2019 Norway and Denmark	The study aimed to explore stroke survivors experienced quality of life during the first year of recovery in north Norway and central Denmark.	A qualitative analysis was used in this study. Individual, in-depth, semi-structured interviews were used. All interviews were conducted in participants homes or workplaces.	Sample: 11 participants were recruited (four females and seven males), five participants were from Norway and six participants from Denmark. Current age of participants ranged from 35- 66 years. Recruitment method: participants were recruited by health personnel in hospitals.	An interpretive inductive approach shaped the interview process and the processing of data.	One overall theme was identified: -Reconstruction of the embodied self. Two main themes were identified: 1. The embodied self Three subthemes: -The familiar self, -The unfamiliar self, -Recovery of the self. 2. Being, doing, belonging, and becoming Four subthemes: -Overwhelming tiredness,

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
						-Valued activities, -Enriching social relations, -Professional support.
6.	Young et al., 2013 UK	The aim of the study was to explore the potential physical, psychological, and situational nature of fatigue as well as the consequences of fatigue on stroke survivors' lives.	A qualitative analysis was used in this study. Single, semi-structured, open-ended interviews were undertaken individually with each participant in the hospital, in a private room.	Sample: 10 participants were recruited (six males and four females), with a mean age of 52 years. Nine participants had suffered ischemic stroke and one haemorrhagic stroke. Recruitment method: Participants were recruited from the site hospital following approval from the local NHS research Ethics	An interpretive phenomenological analysis (IPA) was used to analyse the narratives of the 10 participants.	Six themes were identified: 1.Tiredness/sleep. Three subthemes: -Sleep, -Tiredness, -Exhaustion 2. Restriction. One subtheme: -Limitations 3. Frustration Three subthemes: -Poor coping, -Boredom, -Lack of control. 4. Depression.

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
				Committee and research governance procedures.		Four subthemes: -Mood swings, -Poor motivation, -Doing nothing, -Depression. 5.Determination/coping. Three subthemes: -Achievement, -Goal setting, Control. 6. Support Two subthemes: -Mood, -Advice.
7.	Askari et al., 2023 Canada	The aim of this study was to explore post-stroke cognitive fatigue and	A qualitative research methodology was followed following the	Sample: 11 participants were recruited (six females, 4	An inductive content analysis method was used.	Five themes were identified: 1. Characteristics, 2. Aggravating factors,

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
		communicate this experienced by stroke survivors.	principles of descriptive phenomenology. Individual semi-structured interviews were conducted with stroke survivors experiencing post-stroke fatigue. Interviews were conducted using Microsoft Teams and Blackboard Collaborate as all eligible participants had access to the Internet.	males and 1 transgender male). Recruitment method: purposive sampling. Participants were recruited through multiple methods, including online posters on social media (Twitter and Facebook), and postings in newsletter and on websites for the Heart and Stroke Foundation and the Canadian Partnership for Stroke Recovery.		3. Management, 4. Effect of cognitive fatigue on daily life, 5. Social awareness and support.
8.	Connolly & Mahoney, 2018 USA	The aim of the study was to investigate the experiences of ischemic stroke survivors during the	This was a qualitative descriptive study.	Sample: 31 participants were recruited for this study	A thematic analysis was used in this study.	Five themes were identified: 1. The shock of a stroke interrupting a normal day,

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
		transitional period from the hospital through the first four weeks after discharge home.	The study used semi structured telephone interviews.	(17 males and 14 females). Recruitment was based on a purposive sampling from two medical surgical neurological units at Massachusetts General Hospital.		2. Transition to an unfamiliar home, 3. Uncertainty, 4. Understanding a new sense of self, 5. Adjusting to a new sense of self.
9.	Alenljung et al., 2018 Sweden	The aim of this study was to explore how women of working age who have had a mild stroke resulting in cognitive impairment experience and manage their everyday lives.	A qualitative methodology was used in the study and data collected using semi-structured interviews. Interviews were conducted at a rehabilitation unit.	Sample: 10 participants were recruited for this study (all females). Current age of participants ranged from 38-64 years. Recruitment method: A purposeful sample was selected from a	Qualitative content analysis method was used to analyse data.	Three main themes were identified: 1. The everyday is affected by the symptoms Three subthemes: -Uncertainty about their ability, -Changed everyday life, -Difficult to live up to their own requirements. 2. Living strategies

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
				rehabilitation unit in primary care.		Two subthemes: -Make choices in everyday life, -new solutions. 3. The social environment effects and changes Two subthemes: -Changes in the family, -Lack of understanding from the environment.
10.	Eriksson et al., 2022 Sweden	The aim of this study was to explore how post-stroke fatigue was experienced and managed among people with stroke in the performance of everyday activities and in participation in social activities five years after stroke.	A qualitative method with an inductive approach was used in the study. Data collection was performed through individual open-ended, semi-structured interviews.	Sample: Nine participants were recruited for this study (eight males and one female). Their median age was 65 years. Recruitment method: the participants of this	A qualitative inductive content analysis was chosen to analyse the data.	One theme and three categories were identified: Theme 1. Handling post-stroke fatigue- a long slow process with invisible adjustments and at a slower pace. Categories: 1. Fatigue – a sudden change felt in body and mind

Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
				study had previously participated in a multi-centre randomised controlled trial. Participants were followed up five years later.		2.Living life peacefully and a slower pace Preparing, concentrating, and resting- necessary to continue doing Change or stop doing – a way to handle complex activities 3. Meeting people is fun but needs to be planned Support and strategies improve everyday life Information about post-stroke fatigue generates understanding and support Strategies and daily routines make post-stroke fatigue less noticed.
11.	Kristensen et al., 2014	The aim of this study was to investigate the subjective experiences	A qualitative research approach was used in this study.	Sample: Eight participants (six males and two females)	A phenomenological-hermeneutic theoretical approached	Three themes were identified:

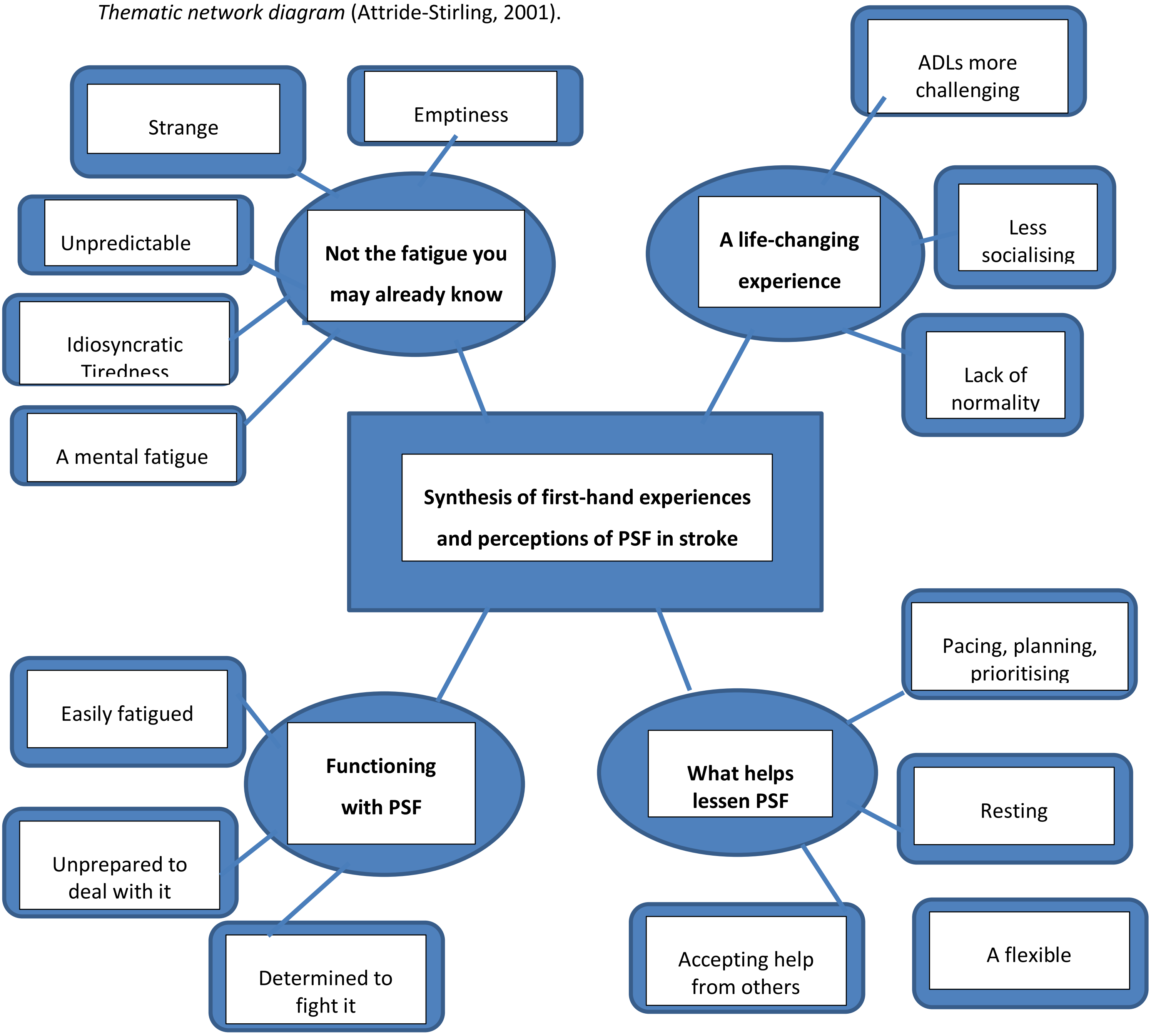
Study Number	Author/Year/Country	Aim	Qualitative Data and method	Sample/ Recruitment method	Data Analysis Method	Key findings
	Denmark	of occupational performance of activities of daily living in patients with mild stroke.	The study used semi structured interviews which were conducted over the telephone.	were used in the analysis. Recruitment method: Participants had previously taken part in a similar study; "Activities of Daily Living" Interview Study- only these eight participants were asked to elaborate on their experiences of occupational performance after discharge (as opposed to the other 33). These eight interviews were analysed separately and hence considered in this systematic review.	was used to analyse data.	1. Occupational balance Two subthemes: -Maintaining occupational balance -Changing occupational balance. 2.Adaptation Two subthemes: -Change of role, -Change of structure in daily activities. 3.Emotional reactions. Two subthemes: -Anxiety, -Pensiveness.

1.5 Findings

From the thematic synthesis, four main themes and 15 subthemes were identified (see Figure 1.2).

Figure 1.2

Thematic network diagram (Attride-Stirling, 2001).



Note. Within this figure (rectangle represents research question, circles represent analytical themes and rounded rectangles represent sub-themes).

1.5.1 Theme 1: Not the fatigue you may already know

Most participants found it challenging to describe PSF and various terms were used to communicate the PSF experience. Even so, they acknowledged that it was in some way different to previous experiences of fatigue. This theme was further expanded into five subthemes.

Emptiness

PSF was described as a "*sense of absence*", an "*emptiness in the head like an invisible disability*", as if a "*window blind was suddenly pulled down*" (Askari et al., 2023, Eriksson et al., 2022, Tremayne et al., 2020, Worthington et al., 2017, Young et al., 2013). Participants reported that PSF felt as if they had been somewhere else: "*I tried to go to the shop at times when there are few people there, I get so tired in the head, it feels completely empty and then I get a headache*" (Eriksson et al., 2022). Another participant reported "*you're trying to work it so much but it's like the brain just not doing anything*" (Young et al., 2013). Speaking about this sense of emptiness, another participant reported: "*It's feels like nothing…I remember before my stroke people saying to me, "oh my God, I'm so tired" and I'm thinking to myself, "tired from what?... they don't know what it means to be like truly tired*" (Askari et al., 2023).

Strange

A participant reported that PSF is "*a strange kind of tiredness unlike any other tiredness they had experienced before*" (Christiansen et al., 2020). Other participants described PSF as "an *abnormal type of fatigue* causing a*n overall reduction in drive, stamina, and energy levels*", a "*constant effort*" and a "*salient concern*" (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Worthington et al., 2017, Young et al., 2013). Participants reported feeling low in energy, run down, and overwhelmed as if everything required greater effort: "*I felt quite tired, and I felt different…"* and that *"this different feeling of tiredness completely changed my life" (*Alahmari et al., 2023, Askari et al., 2023). PSF was also described as an overshadowing consequence of persistent tiredness (Alenljung et al., 2018, Pedersen et al., 2019, Young et al., 2013). A participant said: "*it's feels like there is a hangover that lasts"* (Young et al., 2013).

Unpredictable

PSF was described to be unpredictable (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Eriksson et al., 2022, Tremayne et al., 2020, Worthington et al., 2017). Some participants experienced PSF continuously, while others had more intermittent symptoms and moments of respite (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Worthington et al., 2017, Young et al., 2013), "*And the next day, back to normal… it is not consistent you know*" (Alahmari et al., 2023), "*I can walk probably three miles with the dog, but the day after I had it*", "*… by the time I'd* *walked form the lounge to the kitchen and made myself a cup of tea and come back again I was really tired…"* (Worthington et al., 2017). One participant said: *"I feel it all day"*, whereas another reported *"I feel a spasmodic sense of "tiredness" of the body and the mind which varied in duration*" (Young et al., 2013). "*There will come a point where I can focus for a period of time, but then I hit a wall and then after that I just becomes so difficult to keep up"* (Askari et al., 2023). Similarly, another participant reported: "*often PSF comes unannounced, you are doing things and just suddenly you 've got to stop. It's like I've lost control*" (Tremayne et al., 2020). Lastly, a participant said: "*sometimes it catches me 'on the hop' I don't know why, I can't explain it… it just comes and does what it wants, there is nothing that sets it off*" (Worthington et al., 2017).

Idiosyncratic tiredness

Variable descriptions of the experiences of PSF were reported by participants. Stroke survivors described that when they got fatigued, they felt stressed, frustrated, irritated or angry (Alahmari et al., 2023, Alenljung et al., 2018, Askari et al., 2023, Eriksson et al., 2022, Kristensen et al., 2014, Tremayne et al., 2020, Worthington et al., 2017, Young et al., 2013). Moreover, when participants became fatigued, they experienced annoyance, mood disturbances, signs of depression and helplessness, feelings of anxiety and uncertainty, and feelings of guilt and poor motivation. "*Not being able to do what you could do, and the frustration of that…. how can I let this thing happen to me is what hurts me the most"* (Alahmari et al., 2023). Another participant reported: *"I've lost that bit of enthusiasm" … "Sluggishness makes me feel disappointed and causes me to cry for no reason"* (Worthington et al., 2017). Whereas another participant said: "*If I am tired, I'm annoyed, and I get upset about things which I normally would not"* (Eriksson et al., 2022).

Other descriptions of PSF included more physical symptoms such as dizziness, nausea, or slurred speech (Alahmari et al., 2023, Askari et al., 2023, Kristensen et al., 2014, Tremayne et al., 2020, Worthington et al., 2017). Participants also reported pains, weakness, sleepiness, loss of balance, lack of energy, headaches, and tachycardia and mobility difficulties: "*I feel heartache with a rapid pulse, and tiredness and sluggishness", "PSF makes my movement a lot harder and with the standing it can make me more wobbly when I'm tired"* (Alahmari et al., 2023, Tremayne et al., 2020). Another participant reported: "I*f I am tired, I know my speech and swallow will be worse, so I have to concentrate more*" (Tremayne et al., 2020). Other accounts described PSF as a need for more sleep and rest*: "I am always asleep, always in bed…", "whenever I have a second, I go to sleep", "I've got to have a sleep… I didn't sleep much at all before, now I can sleep… much longer"* (Young et al., 2013). Collectively, this highlights the idiosyncratic nature of fatigue for stroke survivors.

Mental fatigue

PSF was described as a "*mental fatigue"* (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Eriksson et al., 2022, Tremayne et al., 2020, Worthington et al., 2017). Participants associated their "*mental fatigue*" with cognitive symptoms they experienced such as concertation difficulties, cognitive slowing, inability to solve problems, lacking perspective, and remembering things. Participants reported that activities requiring many decisions were also making them feel mentally tired. Initiating or organising an activity were other hardships participants mentioned which was causing them to experience mental fatigue. Mental fatigue was also described as an inability to focus and hold a conversation: "*I don't really get physically tired, for me it's mostly mental"* (Alahmari et al., 2023). Another participant said: *"My tiredness is linked to concentration, such as when I'm talking to you or reading something"* (Tremayne et al., 2020). Similarly, another participant reported: "*I call it the hangover, but it's like the cognitive hangover for just the next few days after I've exerted myself… or done something really intense that needs a lot of brain power*" (Askari et al., 2023).

1.5.2 Theme 2: A life-changing experience

The transformative and restricting experience of PSF was illustrated in all studies. PSF was portrayed as a disruptive phenomenon, influencing their overall existence and reconstruction of their quality of life. Participants spoke about how changes in their capacity and energy levels affected their sense of normality and everyday activities, their ability to work, to engage in leisure and social activities, their relationships with other people and their own sense of self. This theme was demonstrated in three subthemes.

Activities of Daily Life (ADLs) more challenging

Participants stated that PSF made every day self-care activities such as eating, bathing, dressing, and showering more challenging and tiring (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Connolly & Mahoney, 2018, Eriksson et al., 2022, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017). Moreover, activities like walking, driving, and using public transport which were easy to perform before experiencing PSF, had now become more challenging. In addition, participants mentioned that ADLs that required many decisions, sustained attention, and planning, such as shopping, were also affected by their PSF and these activities took up much more time than before experiencing PSF. A participant reported: "*Driving a car, I noticed that it was not good, there are so many impressions that flow against you. You see and hear things around you all the time as if they are just bombarding you with impressions"* (Eriksson et al., 2022). Another participant said: "*Sometimes I feel so tired even just to eat my meal or go to the toilet*" (Alahmari et al., 2023). To illustrate the difficulty of going shopping a participant said: "*Like the days I go shopping, when I come* *back and by the time I've unloaded, I've put everything away and everything, I'm flaked, I'm tired out"* (Worthington et al., 2017).

Less socialising

PSF adversely impacted on participation in social activities (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Eriksson et al., 2022, Kristensen et al., 2014, Pedersen et al., 2019, Worthington et al., 2017). Participants stated that PSF limited their interpersonal interactions including informal meetings with other people and participation in social events. Participants reported having difficulties being social, engaging in hobbies with other people and keeping up with friends and family gatherings due to PSF: "*I know that one of the biggest ways it's affected me is social interaction", and "if I'm out in a social situation, that's crowded, family gatherings terrify me because they are exhausting"* (Askari et al., 2023). Another participant reported: *"It was my grandson's birthday on Sunday… there was a huge party… it as fabulous but my tiredness spoilt it and that was annoying"* (Worthington et al., 2017). Finally, one participant said: "*I used to be a very social person, and now I am afraid to go out"* (Pedersen et al., 2019).

Lack of normality

Participants reported that PSF was a prominent reason for lacking normality in their lives (Alenljung et al., 2018, Askari et al., 2023, Connolly & Mahoney, 2018, Christiansen et al., 2020, Eriksson et al., 2022, Pedersen et al., 2019). Participants had to reinvent themselves and reconstruct a new sense of normality which was quite different to the one before PSF: "*before I used to do a million things in a day… now, I'm lucky if I do two or three"* (Askari et al., 2023). Participants saw themselves as being in a stage of convalescence but hoped they would soon revert to their premorbid self/level of functioning: "*and you wanted to be just like you used to be, even though you felt that you were not*" (Pedersen et al., 2019).

1.5.3 Theme 3: Functioning with PSF

Participants reported the experience of learning to 'function' with PSF in all papers. Participants had to understand how much energy was available to them day-to-day and what was draining their energy resources, learn about this new situation and realise they had to push themselves each day to fight PSF. This theme was further developed in three subthemes.

Easily fatigued

Participants reported getting easily fatigued and spoke about multiple factors which exacerbated their PSF (Alahmari et al., 2023, Alenljung et al., 2018, Askari et al., 2023, Christiansen et al., 2020, Connolly & Mahoney, 2018, Eriksson et al., 2022, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017). These included stimuli-intensive environments, lights, sounds and visual impressions, crowded environments, experience of intense emotions, performance of complex or cognitive loaded activities including everyday activities, physical exertion, and poor sleep. In addition, participants reported extensive periods of inactivity or sedentary activity, long periods of resting, lack of socialising and isolation as caused by their PSF. A participant reported: *"I do note that sensory overload is huge in contributing to my fatigue… so if I'm in a noisy environment or, you know, there's more than one speaker going on or even music and a conversation going on, I really have difficulty"* (Askari et al., 2023). Another participant said*: "TV commercials had too many visual impressions and sounds which made me tired" (*Eriksson et al., 2022).

Unprepared to deal with it

Another subtheme was the lack of knowledge about functioning with PSF (Alahmari et al., 2023, Alenljung et al., 2018, Askari et al., 2023, Christiansen et al., 2020, Eriksson et al., 2022, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017). Participants noted that they had not received specific information about PSF, either spoken or written, from their health-care team and were lacking awareness regarding fatigue as a post-stroke symptom and its consequences: "*Nobody, and I've had several therapists and doctors, etc., nobody knows anything about cognitive fatigue*", "*I don't think anyone has spoken to me about it*", "*I have not received any education about fatigue from doctors… I thought it was a normal feeling*", "*They didn't tell me anything about it in the hospital"* (Alahmari et al., 2023, Aksari et al., 2023, Tremayne et al., 2020, Worthington et al., 2017). Participants expressed that lacking knowledge in how to deal with PSF had negatively impacted their rehabilitation, their functional abilities and overall wellbeing: "*If information had been given to my wife and acquaintances (about the nature and managing of PSF), I might have accepted (it)…. You were not really involved in conversations around PSF…."* (Eriksson et al., 2022). In some cases, limited information regarding the management of PSF was given to participants from healthcare services. This, however, was described to be deficient, inaccurate and on many occasions non-existent: "*I think they should have discussed tiredness with us in a way we could understand and plan for it, rather than wonder why everything seemed really hard"* (Tremayne et al., 2020).

Determined to fight it

Another subtheme that emerged was participants' determination to cope with PSF (Alahmari et al., 2023, Askari et al., 2023, Christiansen et al., 2020, Connolly & Mahoney, 2018, Kristensen et al., 2014, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017, Young et al., 2013). Participants reported fighting it by gradually pushing themselves physically and mentally. Despite the intense feeling of PSF, many participants reported being determined not to give into such feelings: "*Sometimes if I get tired, I try to get up and say to myself… don't give up"* (Alahmari et al., 2023). Another participant said: *"It's dead easy to say no, and I try not to do that… I try to push myself all* *the time, and that's what I have been doing…. It's dead easy to do nothing, but I won't"* (Worthington et al., 2017). Other participants reported that accepting their post-stroke self and adapting to the new situation increased their quality of life and helped them feel more determined to fight it, "*previously, I could not accept that I had to let go of my regular work… right now, I do not feel I had to let go of anything" (*Pedersen et al., 2019). Another participant said: *"I think the main thing is accepting what happened because unless you accept it you can't necessarily deal with it and move on from it"* (Tremayne et al., 2020).

1.5.4 Theme 4: What helps lessen PSF

Participants in all papers reported strategies that helped them lessen the experience of PSF. Participants reported that these strategies were identified through trial and error and by gaining insight into the complex phenomenon of PSF. This theme was further developed in three subthemes.

Pacing, planning, prioritising

Participants reported pacing and planning to be helpful in managing PSF (Alenljung et al., 2018, Eriksson et al., 2022, Kristensen et al., 2014, Pedersen et al., 2019, Tremayne et al., 2020). Participants expressed a slower pace and prioritisation of more meaningful activities enabled them to manage their energy resources based on the demands and expectations of their day, *"you decide, that you have Tuesday as a day of cleaning, Thursday as a day of shopping… that you get in such routines that you will learn to do some activities and not other activities that day… a schedule maybe"* (Alenljung et al., 2018). Another participant reported *"then I have to take it bit by bit… I may peel the potatoes in the morning and then do something more in the afternoon"* (Kristensen et al., 2014). Prioritising meaningful activities over less valued commitments was deemed necessary in successfully distributing their energy resources "*I have to keep the house clean… everyone must have food in the evening… that's the most important thing*" (Alenljung et al., 2018).

Resting

Resting was also reported to be helpful in the management of PSF (Alahmari et al., 2023, Aksari et al., 2023, Eriksson et al., 2022, Kristensen et al., 2014, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017). Resting methods varied among participants with some prioritising physical rest such as sleep, whilst others preferred mental rest. Incorporating periods of rest in their days enabled participants to resume valued activities: *"After I have vacuumed and cleaned a little then I rest for a while and then half an hour later I can mop the floors"* (Eriksson et al., 2022). *"My biggest issue right now is that is that I need an hour to rest in the afternoons – it is a necessity to function the rest of the day and gain some energy"* (Pedersen et al., 2019). Another participant said: "*The red* *cross very kindly brought me a perching stool which is still in the kitchen, and I still use it sometimes, because when I am chopping, I think, come on sit down, you're feeling tired, rest your legs*" (Worthington et al., 2017). Similarly, another participant reported "*I rest and sleep when I feel tired. After that, I feel like I can move*" (Alahmari et al., 2023).

A flexible approach

Participants reported that adopting an individualised and multi-faceted approach may be necessary for managing PSF (Askari et al.,2023, Christiansen et al., 2020, Eriksson et al., 2022, Tremayne et al., 2020, Worthington et al., 2017). Many participants reported that they had altered their expectations and made some compromises on becoming more flexible in handling post-stroke life, "*I don't push myself too hard now. If it's not going to get done today, then fair enough it won't get done"* (Worthington et al., 2017). Another participant reported *"Me and my wife have just adjusted to PSF and changed our priorities and expectations a bit, just changed our activities and rest as we need. It's about keeping flexible"* (Tremayne et al., 2020). Similarly, another participant said: "*Uh, while respecting a deadline, I have to be flexible and organise myself to always have plenty of time to do cognitive tasks that require time and thought*" (Askari et al., 2023).

Accepting help form others

Participants stressed that accepting help from others including family members, friends, and neighbours helped them (Alenljung et al., 2018, Christiansen et al., 2020, Connolly & Mahoney 2018, Eriksson et al., 2022, Pedersen et al., 2019, Tremayne et al., 2020, Worthington et al., 2017). A participant said: *"I go and ask for help"* (Eriksson et al., 2022). Another participant reported, "*My life is turned upside-down, and I have to ask others to help"* (Pedersen et al., 2019). Moreover, talking to health care professionals and care assistants and accepting help form them increased their underrating of PSF, *"By talking about it, it makes it clearer. You understand it more and accept it more as well"* (Tremayne et al., 2020).

1.6 Discussion

This synthesis of qualitative research on stroke survivors' experiences of PSF provided some significant insights into the experience of PSF. The synthesis process elicited four main analytical themes: "Not the fatigue you may already know", "A life-changing experience", "Functioning with PSF" and "What helps lessen PSF" and many subthemes.

PSF appeared to be a discrete type of fatigue unlike any other type of fatigue or tiredness participants had experienced prior to the stroke. These findings are in line with previous studies.

Barbour and Mead (2012) found PSF to be very different from any other experiences of fatigue participants have had prior to their stroke. Similarly, Kirkevold et al. (2011) found that PSF was a new life experience very different to ordinary experiences of tiredness prior to stroke. Whitehead et al. (2016) also found PSF to be a discrete type of fatigue and disparate to other long-term conditions, such as cancer and HIV.

Our findings are consistent with a previous systematic review on PSF by Eilertsen et al. (2012). Researchers had identified five core characteristics of PSF including unpredictable feelings of fatigue without explanation, lack of energy to perform activities, an abnormal need for long-lasting sleep, getting easily tired by activities and increased stress sensitivity. Although the first three characteristics of PSF as identified by Eilertsen et al. (2012) were evident in our analysis too, getting easily tired was understood as part of participants' experience of living with PSF rather than a separate characteristic of PSF. Our analysis did not identify increased stress sensitivity to be among participants' experiences of PSF.

We also found that stroke survivors varied substantially in their personal experience of PSF. This is in line with a previous study which explored similarities and differences in the experience of fatigue among people living with long term-illnesses (Eilertsen et al., 2015). Researchers found PSF to be a varying condition as opposed to the experience of fatigue in patients with fibromyalgia or multiple sclerosis, which appeared to be more constant.

Participants reflected upon the life-changing, transformative, and restricting experience of PSF. Stroke survivors referred to the impact PSF had on activities of daily life rendering them more challenging and tiring. Participants were also reflective of the impact of PSF on their ability to socialise and spend time in the presence of other people. These findings were in line with a systematic review which explored the impact of PSF on stroke survivors which concluded that the biggest impact of PSF seems to be on patients' activities of daily life (Lerdal et al., 2009). We also found PSF to impact stroke survivors' life in a variety of ways resulting in lack of normality. This finding is consistent with Muina-Lopez and Guidon (2013) who found that individuals with greater levels of PSF had lower self-efficacy and poorer functional ability.

Functioning with PSF appeared to be influenced by several factors. Stroke survivors reflected on the fragility of their energy resources and identified multiple triggers which exacerbated their experience of PSF. Lack of knowledge of how to live with PSF was another commonly reported factor in the dysfunctional experience of PSF. Eilertsen et al. (2012) found that stroke survivors made great efforts to make sense of their PSF experience, did not anticipate that it would be part of their rehabilitation trajectory, and lacked the knowledge to function with PSF. Similarly, our analysis identified lack of knowledge of how to deal with PSF to be a common experience for stroke survivors. In contrast, determination to fight PSF appeared to be a helpful stance in functioning with PSF.

Stroke survivors reflected on what has been helpful in lessening the experience of PSF. Pacing, and planning was deemed to be helpful in managing PSF. Stroke survivors also found prioritising meaningful activities over less valued commitments to be an effective strategy to successfully distribute energy resources. These strategies have been previously described as effective techniques for managing PSF (Flinn & Stube, 2009). Moreover, these findings are consistent with results from current therapeutic approaches and interventions for the management of fatigue. Pacing interventions have been found to be effective in reducing fatigue and psychological distress and improve physical functioning in chronic fatigue syndrome (Casson et al., 2022). Similarly, psychological therapies such as cognitive behavioural therapy (CBT), which involves the use of pacing, have been found promising in managing fatigue in patients with quiescent disease (Emerson et al., 2021). Poort et al. (2020) found that CBT therapy can reduce fatigue in patients receiving cancer treatment with palliative intent and the benefits of the intervention were sustained for three months post-intervention. Similarly, Nguyen et al. (2017) found that adapted CBT therapy produced greater and sustained improvements in daily fatigue levels compared with treatment as usual in a brain injured group of patients. The stroke participants identified that keeping a flexible approach by altering expectations, making compromises, and accepting help from others, including family members, friends, and health care professionals, to be helpful in managing symptoms of PSF.

Psychological flexibility has also been found to be key in facilitating valued goal pursuits (Doorley et al., 2020). Acceptance and Commitment Therapy (ACT), a therapeutic approach which aims to increase psychological flexibility to foster greater engagement in personally meaningful activities, has been shown to improve the psychological well-being of individuals suffering from a range of chronic health conditions (Roche et al., 2017). Eilertsen et al. (2012) had identified two main coping patterns utilised by stroke survivors to manage PSF symptoms; one in which stroke survivors dismissed PSF manifestations leading inevitably to more distress and one in which stroke survivors acknowledged its consequences and adjusted to the new situation. Although our analysis did not capture the first coping pattern for PSF suggested by Eilersten et al (2013), it found similar coping strategies to be helpful for the management of PSF, which would be consistent with an ACT approach.

1.6.1 Strengths

This review followed an extensive and systematic search for relevant research eliciting 11 studies, a number comparable to the previous systematic review on the same topic conducted by Eilertsen et al. (2012). All studies included in this review have been evaluated for technical and scientific quality and correctness by experts in their field and were published in peer-reviewed databases ensuring high methodological quality. In addition to this, quality of the studies included in this review was assessed through the CASP tool and all studies’ quality was rated as high. Continuous collaboration among the authors in extracting, analysing, and interpreting the data contributed to the validity of the findings.

1.6.2 Limitations

The aim of this review was to produce a synthesis that both generates abstract and formal analytical themes that are nevertheless empirically faithful to the individual studies from which they were developed (Thomas & Harden, 2008). However, the findings of this systematic review should be interpreted with caution given the disadvantages of thematic synthesis as a methodological approach.

It could be argued that by de-contextualising the findings of individual studies, our analytical themes may not be applicable to all settings. To minimise this, we attempted to preserve the context in which every individual study was conducted by providing a summary of every original paper included in this synthesis, including each study’s aims, methods, setting and sample of participants. This would allow for readers of our review to judge for themselves whether the context of the studies included in this review are similar to their own.

Although three researchers were involved in this systematic review and analytical themes were discussed among the researchers, only the main researcher extracted data from the 11 identified papers. There is a risk that the main researcher might have selectively focused on information that confirmed predefined themes while they disregarded evidence which may contradict them. This might have led to confirmation bias in the analysis and interpretation of the results (McSweeney, 2021).

Although we thoroughly described the qualitative method utilised to conduct this systematic review, the integrity of our conclusions could have been enhanced using a detailed and reflexive account of the procedures and methods followed (Roberts et al., 2019). This would enable readers of this review to see how lines of inquiry led to the formation of descriptive and analytical themes and how conclusions were reached to further enhance the validity and trustworthiness of our results.

The steps outlined by Thomas and Harden (2008) were closely followed by researchers to conduct this review. It should be acknowledged though that thematic synthesis allows for considerable flexibility unlike other methods of analysis which include more rigid analytical frameworks. The absence of a more standardised process to analyse data could hinder reliability of our results. Future research could analyse our data using different techniques and methods of analysis to further establish the reliability of our conclusions.

Another limitation of this review is the limited number of studies contributing to the synthesis of stroke survivors' experiences of PSF. This, however, highlights the limited research in this area and the need for further exploration of this complex phenomenon. Most of the papers included in this review, recruited participants from western countries and only one paper's participants were from a non-western culture. It could be that our analysis does not represent the experiences of PSF of more than one culture, or that stroke survivors from other cultures might communicate a different experience of PSF.

1.6.3 Implications

To the researchers' knowledge this is the first systematic review to explore the experiences of PSF in stroke survivors since 2012. Although it has been 12 years since the last systemic review, only 11 papers were elicited for our analysis highlighting how research within this area is under-researched.

Cultural context can affect how changes in self-concepts are either valued or tolerated (Haas & vanDellen, 2020). Further research is necessary to establish whether different cultures may contribute differently to the experience of PSF. The social meaning of stroke has been found to be an important factor to consider for the development of effective intervention strategies for stroke (Sanuade, 2018). Future research should include stroke survivors from more cultures to investigate the potential differences in the experience of PSF.

The findings of this review can inform psychoeducation materials on PSF. Psychoeducation usually includes certain basic components of information, which are to be given to patients and their family members regarding a particular difficulty (Sarkhel et al., 2020). Our findings can provide patients and their relatives with a basic knowledge and understanding of the experience of PSF, which can provide an insight into this difficulty. For example, educating future stroke survivors who experience PSF that this type of fatigue is very different to any other type of fatigue can support their conceptualisation of their experience.

Future research can explore the benefits of psychoeducation in the management of PSF. Single case experimental design studies are often used to rigorously test the success of an intervention or treatment on a particular case (Epstein & Dallery, 2022). Following a patient's PSF rehabilitation journey could demonstrate whether providing stroke survivors information around PSF can reduce their PSF levels.

This review has synthesised the experience of PSF in 141 stroke survivors and has carefully described the concept of PSF. It could be argued that this can form the basis for the development of a new psychometric tool for measuring PSF which can become part of an initial assessment for PSF. Although this is a process which may require more descriptions of PSF, as concepts need to be clearly defined before the development of a new instrument, our findings around PSF could be operationalised into items which could measure the phenomenon of PSF at a simple and clearly understandable level (Mikkonen et al., 2022). For example, it could be that a questionnaire measuring the experience of PSF has items such as: "*Is you fatigue unpredictable*?" or "*Does it ever feel like a window blind was suddenly pulled down?".* This could help clinicians identify signs of PSF and differentiate it to other types of fatigue, whilst normalising patient experiences.

The findings of this review can provide the foundations for the development of an initial PSF formulation for clinical psychology practice. Formulation can be understood as "*a provisional explanation or hypothesis of how an individual comes to present with a certain disorder or circumstance at a particular point in time*" (Johnstone & Dallos, 2006). One of the most popular approaches in formulating a patient's difficulties is the "Five Ps" approach (Macneil et al., 2012). In the Five Ps approach some key themes exist around the process of formulating a patient's difficulties which include information about the presenting problem, the predisposing, precipitating, perpetuating and protective factors of a problem. The findings of this review can support clinicians in formulating stroke survivors' experience of PSF. For example, findings of this review include information about the nature of PSF, how PSF is experienced and how it feels. This could potentially inform the theme of the Five Ps formulation approach around presenting problems of PSF. Stroke survivors also spoke about getting easily fatigued and identified factors which exacerbated their PSF. This could inform themes around triggering and maintaining factors of PSF. Moreover, findings of this review suggest that stroke survivors' experience of PSF improved with the use of pacing, planning, and prioritising. It could be argued that these findings can inform the theme of the Five Ps formulation approach around protective factors of a difficulty.

1.7 Conclusions

In conclusion, this systematic review broadened our understanding of PSF and provided the literature with more in-depth descriptions of the nature and experience of PSF. Furthermore, our findings identified how it feels to be living and functioning with this condition, its life-changing challenges, and what helps managing its symptoms. The findings also had clear implications for clinical practice and informing future research. Findings should be interpreted with caution given the limitations of the method used in this systematic review.

1.8 References

Aali, G., Drummond, A., Nair, R. D., & Shokraneh, F. (2020). Post-stroke fatigue: a scoping review. *F1000Research*, *9*, 242. https://doi.org/10.12688/f1000research.22880.2

Aaronson, L. S., Teel, C. S., Cassmeyer, V., Neuberger, G. B., Pallikkathayil, L., Pierce, J., ... Wingate, A. (1999). Defining and measuring fatigue. *Image - The Journal of Nursing Scholarship*, *31*(1), 45–50. https://doi. org/10.1111/j.1547-5069.1999.tb00420.x

Ablewhite, J., Nouri, F., Whisker, A., Thomas, S., Jones, F., Nair, R. D., Condon, L., Jones, A., Sprigg, N., & Drummond, A. (2022). How do stroke survivors and their caregivers manage post-stroke fatigue? A qualitative study. *Clinical Rehabilitation*, *36*(10), 1400–1410. https://doi.org/10.1177/02692155221107738

Acciarresi, M., Bogousslavsky, J., & Paciaroni, M. (2014). Post-Stroke fatigue: Epidemiology, clinical characteristics and treatment. *European Neurology*, *72*(5–6), 255–261.

Alahmari, W., Shalabi, K. M., Basuodan, R., Alhowimel, A., & Alotaibi, M. (2023b). Experiences and Perceptions of Post-Stroke Fatigue among stroke survivors in Saudi Arabia: a qualitative interview study. *Journal of Multidisciplinary Healthcare*, *Volume 16*, 3761–3776. https://doi.org/10.2147/jmdh.s434312

Alenljung, M., Ranada, Å. L., & Liedberg, G. (2018c). Struggling with everyday life after mild stroke with cognitive impairments – The experiences of working age women. *the British Journal of Occupational Therapy/British Journal of Occupational Therapy*, *82*(4), 227–234. https://doi.org/10.1177/0308022618800184

Alghamdi, I., Ariti, C., Williams, A., Wood, E., & Hewitt, J. (2021). Prevalence of fatigue after Stroke: A Systematic review and Meta-analysis. *European Stroke Journal*, *6*(4), 319–332. https://doi.org/10.1177/23969873211047681

Andersen, G., Christensen, D., Kirkevold, M., & Johnsen, S. P. (2011). Post-stroke fatigue and return to work: a 2-year follow-up. *Acta Neurologica Scandinavica*, *125*(4), 248–253. https://doi.org/10.1111/j.1600-0404.2011.01557.x

Askari, S., Harvey, K., & Sam-Odutola, M. (2023). Patients experience of cognitive fatigue post-stroke: an exploratory study. *Disability and Rehabilitation*, 1–8. https://doi.org/10.1080/09638288.2023.2280065

Attride-Stirling, J. (2001). Thematic networks: an analytic tool for qualitative research. *Qualitative research*, *1*(3), 385-405. http://dx.doi.org/10.1177/146879410100100307

Barbour, V., & Mead, G. (2012). Fatigue after Stroke: The Patient’s Perspective. *Stroke Research and Treatment*, *2012*, 1–6. https://doi.org/10.1155/2012/863031

Belur, J., Tompson, L., Thornton, A., & Simon, M. (2018). Interrater Reliability in Systematic Review Methodology: Exploring Variation in Coder Decision-Making. *Sociological Methods & Research*, *50*(2), 837–865. https://doi.org/10.1177/0049124118799372

Boland, A., Cherry, G., & Dickson, R. (2017). *Doing a systematic review: A Student’s Guide*. SAGE.

Booth, A., Papaioannou, D., & Sutton, A. (2012). *Systematic approaches to a successful literature review*. http://lib.ugent.be/en/catalog/rug01:002101878/items/000010929920/

Casson, S., Jones, M. D., Cassar, J., Kwai, N., Lloyd, A. R., Barry, B. K., & Sandler, C. X. (2022). The effectiveness of activity pacing interventions for people with chronic fatigue syndrome: a systematic review and meta-analysis. *Disability and Rehabilitation*, *45*(23), 3788–3802. https://doi.org/10.1080/09638288.2022.2135776

Carroll, C. (2017). Qualitative evidence synthesis to improve implementation of clinical guidelines. *BMJ*, j80. https://doi.org/10.1136/bmj.j80

Carter, S. M., & Little, M. (2007). Justifying knowledge, justifying method, taking action: Epistemologies, methodologies, and methods in qualitative research. *Qualitative Health Research*, *17*(10), 1316–1328. https://doi.org/10.1177/1049732307306927

Critical Appraisal Skills Programme (2018). CASP Qualitative Studies Checklist. Retrieved from: https://casp-uk.net/images/checklist/documents/CASP-Qualitative-Studies-Checklist/CASP-Qualitative-Checklist-2018_fillable_form.pdf

Chaplin, S. (2023). Update on the National Clinical Guideline for Stroke. *Prescriber*, *34*(8–9), 28–30. https://doi.org/10.1002/psb.2088

Christiansen, L. K., Rasmussen, A. M., Mouritzen, H. S., Buus, A. a. Ø., & Grønkjær, M. (2020). Quickly home again: patients' experiences of early discharge after minor stroke. *Scandinavian Journal of Caring Sciences*, *35*(4), 1187–1195. https://doi.org/10.1111/scs.12937

Connolly, T., & Mahoney, E. (2018). Stroke survivors' experiences transitioning from hospital to home. *Journal of Clinical Nursing*, *27*(21–22), 3979–3987. https://doi.org/10.1111/jocn.14563

Cooke, A., Smith, D., & Booth, A. (2012). Beyond PICO. *Qualitative Health Research*, *22*(10), 1435–1443. https://doi.org/10.1177/1049732312452938

Cruzes, D. S., & Dyba, T. (2011). Recommended steps for thematic synthesis in software engineering. *In 2011 International symposium on empirical software engineering and measurement* (pp. 275-284). https://doi.org/10.1109/ESEM.2011.36

Cumming, T., Packer, M., Kramer, S., & English, C. (2016). The prevalence of fatigue after stroke: A systematic review and meta-analysis. *International Journal of Stroke*, *11*(9), 968–977. https://doi.org/10.1177/1747493016669861

Dodgson, J. E. (2019). Reflexivity in qualitative research. *Journal of Human Lactation*, *35*(2), 220–222. https://doi.org/10.1177/0890334419830990

Doorley, J., Goodman, F. R., Kelso, K. C., & Kashdan, T. B. (2020). Psychological flexibility: What we know, what we do not know, and what we think we know. *Social and Personality Psychology Compass*, *14*(12), 1–11. https://doi.org/10.1111/spc3.12566

Eilertsen, G., Ormstad, H., Kirkevold, M., Mengshoel, A. M., Söderberg, S., & Olsson, M. (2015). Similarities and differences in the experience of fatigue among people living with fibromyalgia, multiple sclerosis, ankylosing spondylitis and stroke. *Journal of Clinical Nursing*, *24*(13–14), 2023–2034. https://doi.org/10.1111/jocn.12774

Eilertsen, G., Ormstad, H., & Kirkevold, M. (2012). Experiences of poststroke fatigue: qualitative meta-synthesis. *Journal of Advanced Nursing*, *69*(3), 514–525. https://doi.org/10.1111/jan.12002

Emerson, C., Barhoun, P., Olive, L., Fuller-Tyszkiewicz, M., Gibson, P. R., Skvarc, D., & Mikocka-Walus, A. (2021). A systematic review of psychological treatments to manage fatigue in patients with inflammatory bowel disease. *Journal of Psychosomatic Research*, *147*, 110524. https://doi.org/10.1016/j.jpsychores.2021.110524

Eriksson, G., Larsson, I., Guidetti, S., & Johansson, U. (2022). Handling fatigue in everyday activities at five years after stroke: A long and demanding process. *Scandinavian Journal of Occupational Therapy*, *30*(2), 228–238. https://doi.org/10.1080/11038128.2022.2089230

Epstein, L. H., & Dallery, J. (2022). The family of Single-Case experimental designs. *Harvard Data Science Review*. https://doi.org/10.1162/99608f92.ff9300a8

Flemming, K., & Noyes, J. (2021). Qualitative Evidence Synthesis: Where Are We at? *International Journal of Qualitative Methods*, *20*, 160940692199327. https://doi.org/10.1177/1609406921993276

Flemming, K., Booth, A., Garside, R., Tunçalp, Ö., & Noyes, J. (2019). Qualitative evidence synthesis for complex interventions and guideline development: clarification of the purpose, designs and relevant methods. *BMJ Global Health*, *4*(Suppl 1), e000882. https://doi.org/10.1136/bmjgh-2018-000882

Flinn, N., & Stube, J. (2009). Post-stroke fatigue: qualitative study of three focus groups. *Occupational Therapy International*, *17*(2), 81–91. https://doi.org/10.1002/oti.286

Fossey, E., Harvey, C., McDermott, F., & Davidson, L. (2002). Understanding and evaluating qualitative research. *Australian and New Zealand Journal of Psychiatry*, *36*(6), 717–732. https://doi.org/10.1046/j.1440-1614.2002.01100.x

France, E. F., Uny, I., Ring, N., Turley, R. L., Maxwell, M., Duncan, E. a. S., Jepson, R. G., Roberts, R. J., & Noyes, J. (2019). A methodological systematic review of meta-ethnography conduct to articulate the complex analytical phases. *BMC Medical Research Methodology*, *19*(1). https://doi.org/10.1186/s12874-019-0670-7

Glader, E., Stegmayr, B., & Asplund, K. (2002). Poststroke fatigue. *Stroke*, *33*(5), 1327–1333.

Graham, H., De Bell, S., Flemming, K., Sowden, A., White, P. C. L., & Wright, K. (2018). Older people's experiences of everyday travel in the urban environment: a thematic synthesis of qualitative studies in the United Kingdom. *Ageing & Society*, *40*(4), 842–868. https://doi.org/10.1017/s0144686x18001381

Haas, B. W., & vanDellen, M. R. (2020). Culture is associated with the experience of Long-Term Self-Concept changes. *Social Psychological & Personality Science*, *11*(8), 1047–1056. https://doi.org/10.1177/1948550619893966

Hammarberg, K., Kirkman, M., & De Lacey, S. (2016). Qualitative research methods: when to use them and how to judge them. *Human Reproduction*, *31*(3), 498–501. https://doi.org/10.1093/humrep/dev334

Hannes, K., & Macaitis, K. (2012). A move to more systematic and transparent approaches in qualitative evidence synthesis: update on a review of published papers. *Qualitative Research*, *12*(4), 402–442. https://doi.org/10.1177/1468794111432992

Hinkle, J. L., Becker, K. J., Kim, J. S., Choi-Kwon, S., Saban, K. L., McNair, N. D., & Mead, G. (2017). Poststroke Fatigue: Emerging Evidence and Approaches to Management: A scientific statement for healthcare professionals from the American Heart Association. *Stroke*, *48*(7). https://doi.org/10.1161/str.0000000000000132

Hofmeister, M., Memedovich, A., Dowsett, L. E., Sevick, L., McCarron, T. L., Spackman, E., Stafinski, T., Menon, D., Noseworthy, T., & Clement, F. (2018). Palliative care in the home: a scoping review of study quality, primary outcomes, and thematic component analysis. *BMC Palliative Care*, *17*(1). https://doi.org/10.1186/s12904-018-0299-z

Johnstone, L., & Dallos, R. (2006). Formulation in psychology and psychotherapy. In *Routledge eBooks*. https://doi.org/10.4324/9780203087268

Kennedy, C., & Kidd, L. (2018). Interventions for post-stroke fatigue: A Cochrane review summary. *International Journal of Nursing Studies*, *85*, 136–137. https://doi.org/10.1016/j.ijnurstu.2017.11.006

King, D., Wittenberg, R., Patel, A., Quayyum, Z., Berdunov, V., & Knapp, M. (2020). The future incidence, prevalence and costs of stroke in the UK. *Age And Ageing*, *49*(2), 277–282.

Kirkevold, M., Christensen, D., Andersen, G., Johansen, S. P., & Harder, I. (2011). Fatigue after stroke: manifestations and strategies. *Disability and Rehabilitation*, *34*(8), 665–670. https://doi.org/10.3109/09638288.2011.615373

Kristensen, H. K., Postat, A., Poulsen, T., Jones, D. L., & Minet, L. K. R. (2014). Subjective experiences of occupational performance of activities of daily living in patients with mild stroke. *International Journal of Therapy and Rehabilitation*, *21*(3), 118–125. https://doi.org/10.12968/ijtr.2014.21.3.118

Kuriakose, D., & Xiao, Z. (2020). Pathophysiology and Treatment of Stroke: Present status and future Perspectives. *International Journal of Molecular Sciences*, *21*(20), 7609.

Lerdal, A., Bakken, L., Kouwenhoven, S. E., Pedersen, G., Kirkevold, M., Finset, A., & Kim, H. S. (2009). Poststroke Fatigue—A review. *Journal of Pain and Symptom Management*, *38*(6), 928–949. https://doi.org/10.1016/j.jpainsymman.2009.04.028

Lerdal, A., & Gay, C. L. (2017). Acute-Phase Fatigue Predicts Limitations with Activities of Daily Living 18 Months after First-Ever Stroke. *Journal of Stroke and Cerebrovascular Diseases*, *26*(3), 523–531. https://doi.org/10.1016/j.jstrokecerebrovasdis.2016.11.130

Long, H. A., French, D. P., & Brooks, J. M. (2020). Optimising the value of the critical appraisal skills programme (CASP) tool for quality appraisal in qualitative evidence synthesis. *Research Methods in Medicine & Health Sciences*, *1*(1), 31-42. https://doi.org/10.1177/2632084320947559

Macneil, C., Hasty, M. K., Conus, P., & Berk, M. (2012). Is diagnosis enough to guide interventions in mental health? Using case formulation in clinical practice. *BMC Medicine*, *10*(1). https://doi.org/10.1186/1741-7015-10-111

Mead, G., Graham, C., Dorman, P., Bruins, S. K., Lewis, S., Dennis, M., & Sandercock, P. (2011). Fatigue after Stroke: Baseline Predictors and Influence on Survival. Analysis of Data from UK Patients Recruited in the International Stroke Trial. *PLoS One*, *6*(3), e16988. https://doi.org/10.1371/journal.pone.0016988

Maeda, Y., Caskurlu, S., Kozan, K., & Kenney, R. (2022). Development of a critical appraisal tool for assessing the reporting quality of qualitative studies: a worked example. *Quality and Quantity*, *57*(2), 1011–1031. https://doi.org/10.1007/s11135-022-01403-y

Maeda, Y., Caskurlu, S., Kenney, R. H., Kozan, K., & Richardson, J. C. (2022). Moving qualitative synthesis research forward in education: A methodological systematic review. *Educational Research Review*, *35*, 100424. https://doi.org/10.1016/j.edurev.2021.100424

McSweeney, B. (2021). Fooling ourselves and others: confirmation bias and the trustworthiness of qualitative research – Part 1 (the threats). Journal of Organizational Change Management, 34(5), 1063–1075. https://doi.org/10.1108/jocm-04-2021-0117

Mikkonen, K., Tomietto, M., & Watson, R. (2022). Instrument development and psychometric testing in nursing education research. *Nurse Education Today*, *119*, 105603. https://doi.org/10.1016/j.nedt.2022.105603

Mountian, I. (2017). Borders and margins: debates on intersectionality for critical research. *Qualitative Research Journal*, *17*(3), 155–163. https://doi.org/10.1108/qrj-11-2016-0071

National Clinical Guideline for Stroke for the UK and Ireland. London: Intercollegiate Stroke Working Party; 2023 May 4. Available at: www.strokeguideline.org.

Muina-Lopez, R., & Guidon, M. (2013). Impact of post-stroke fatigue on self-efficacy and functional ability. *European Journal of Physiotherapy*, *15*(2), 86–92. https://doi.org/10.3109/21679169.2013.792868

Nicholson, E., Murphy, T., Larkin, P., Normand, C., & Guérin, S. (2016). Protocol for a thematic synthesis to identify key themes and messages from a palliative care research network. *BMC Research Notes*, *9*(1). https://doi.org/10.1186/s13104-016-2282-1

Norrving, B., Barrick, J., Dávalos, A., Dichgans, M., Cordonnier, C., Guekht, A., Kutluk, K., Mikulík, R., Wardlaw, J. M., Richard, E., Nabavi, D. G., Molina, C. A., Bath, P. M., Sunnerhagen, K. S., Rudd, A., Drummond, A., Planas, A. M., & Caso, V. (2018). Action Plan for Stroke in Europe 2018–2030. *European Stroke Journal*, *3*(4), 309–336. https://doi.org/10.1177/2396987318808719

Nguyen, S., McKay, A., Wong, D., Rajaratnam, S. M., Spitz, G., Williams, G., Mansfield, D., & Ponsford, J. (2017). Cognitive behaviour therapy to treat sleep disturbance and fatigue after traumatic brain injury: a pilot randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, *98*(8), 1508-1517.e2. https://doi.org/10.1016/j.apmr.2017.02.031

Paciaroni, M., & Acciarresi, M. (2019). Poststroke fatigue. *Stroke*, *50*(7), 1927–1933. https://doi.org/10.1161/strokeaha.119.023552

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T., Mulrow, C. D., Shamseer, L., Tetzlaff, J., Akl, E. A., Brennan, S., Chou, R., Glanville, J., Grimshaw, J., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. https://doi.org/10.1136/bmj.n71

Paudel, S. K., Rolls, K., Green, H., & Fernandez, R. (2023b). Prevalence and impact of poststroke fatigue on patient outcomes in the first 6 months after stroke: a systematic review and meta-analysis. *the Journal of Neuroscience Nursing/Journal of Neuroscience Nursing*, *55*(5), 178–185. https://doi.org/10.1097/jnn.0000000000000716

Pedersen, S. G., Anke, A., Aadal, L., Pallesen, H., Moe, S., & Arntzen, C. (2019). Experiences of quality of life the first year after stroke in Denmark and Norway. A qualitative analysis. *International Journal of Qualitative Studies on Health and Well-being*, *14*(1). https://doi.org/10.1080/17482631.2019.1659540

Roche, L., Dawson, D. L., Moghaddam, N., Abey, A., & Gresswell, D. M. (2017). An Acceptance and Commitment Therapy (ACT) intervention for Chronic Fatigue Syndrome (CFS): A case series approach. *Journal of Contextual Behavioural Science*, *6*(2), 178–186. https://doi.org/10.1016/j.jcbs.2017.04.007

Poort, H., Peters, M. F., Van Der Graaf, W. T., Nieuwkerk, P., Van De Wouw, A. J., Sanden, M. N. D., Bleijenberg, G., Verhagen, C., & Knoop, H. (2020). Cognitive behavioural therapy or graded exercise therapy compared with usual care for severe fatigue in patients with advanced cancer during treatment: a randomized controlled trial. *Annals of Oncology*, *31*(1), 115–122. https://doi.org/10.1016/j.annonc.2019.09.002

Price, A., Wright, F. J., Green, J., Balkwill, A., Kan, S. W., Yang, T. O., Floud, S., Kroll, M. E., Simpson, R. W., Sudlow, C., Beral, V., & Reeves, G. (2018). Differences in risk factors for 3 types of strokes. *Neurology*, *90*(4).

Roberts, K., Dowell, A., & Nie, J. B. (2019). Attempting rigour and replicability in thematic analysis of qualitative research data; a case study of codebook development. BMC Medical Research Methodology, 19(1). https://doi.org/10.1186/s12874-019-0707-y

Saka, Ö., McGuire, A., & Wolfe, C. D. A. (2008). Cost of stroke in the United Kingdom. *Age And Ageing*, *38*(1), 27–32.

Sanuade, O. A. (2018). Understanding the cultural meanings of stroke in the Ghanaian setting: A qualitative study exploring the perspectives of local community residents. *Wellcome Open Research*, *3*, 87. https://doi.org/10.12688/wellcomeopenres.14674.2

Sarkhel, S., Singh, O. P., & Arora, M. (2020). Clinical Practice Guidelines for Psychoeducation in Psychiatric Disorders General Principles of Psychoeducation. *Indian Journal of Psychiatry/Indian Journal of Psychiatry*, *62*(8), 319. https://doi.org/10.4103/psychiatry.indianjpsychiatry_780_19

Schlemmer, T. (2023). Impact of Strokes: The Burden of Care, Post-CVA Fatigue & Caregiver Role Strain. *Open Journal of Nursing*, *13*(08), 487–499. https://doi.org/10.4236/ojn.2023.138032

Staub, F., & Bogousslavsky, J. (2001). Fatigue after Stroke: A Major but Neglected Issue. *Cerebrovascular Diseases*, *12*(2), 75–81.

Thomas, J., & Harden, A. (2008b). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, *8*(1). https://doi.org/10.1186/1471-2288-8-45

Thomas, K., Hjalmarsson, C., Mullis, R., & Mant, J. (2019). Conceptualising post-stroke fatigue: a cross-sectional survey of UK-based physiotherapists and occupational therapists. *BMJ Open*, *9*(12), e033066. https://doi.org/10.1136/bmjopen-2019-033066.

Tremayne, J. E., Freeman, J., & Coppola, A. (2020b). Stroke survivors’ experiences and perceptions of post-stroke fatigue education in the subacute phase of stroke. The FASE qualitative study. *British Journal of Occupational Therapy*, *84*(2), 111–121. https://doi.org/10.1177/0308022620963741

Van Der Werf, S., Van Den Broek, H., Anten, H., & Bleijenberg, G. (2001). Experience of Severe Fatigue Long after Stroke and Its Relation to Depressive Symptoms and Disease Characteristics. *European Neurology*, *45*(1), 28–33. https://doi.org/10.1159/000052085

Vassar, M., Yerokhin, V., Sinnett, P. M., Weiher, M., Muckelrath, H., Carr, B., Varney, L., & Cook, G. (2017). Database selection in systematic reviews: an insight through clinical neurology. *Health Information and Libraries Journal*, *34*(2), 156–164. https://doi.org/10.1111/hir.12176

Vincent, S., & O'Mahoney, J. (2018). Critical Realism and Qualitative Research: An introductory overview. In *SAGE Publications Ltd eBooks* (pp. 201–216). https://doi.org/10.4135/9781526430212.n13

Whitehead, L., Unahi, K., Burrell, B., & Crowe, M. (2016). The Experience of Fatigue Across Long-Term Conditions: A Qualitative Meta-Synthesis. *Journal of Pain and Symptom Management*, *52*(1), 131-143.e1. https://doi.org/10.1016/j.jpainsymman.2016.02.013

Worthington, E., Hawkins, L., & Lincoln, N. B., Drummond, A. (2017). The day-to-day experiences of people with fatigue after stroke: Results from the Nottingham Fatigue After Stroke study. *International Journal of Therapy and Rehabilitation*, *24*(10), 449–455. https://doi.org/10.12968/ijtr.2017.24.10.449

Wu, S., Kutlubaev, M. A., Chun, H. Y., Cowey, E., Pollock, A., Macleod, M., Dennis, M., Keane, E., Sharpe, M., & Mead, G. (2015b). Interventions for post-stroke fatigue. *The Cochrane Library*, *2015*(7). https://doi.org/10.1002/14651858.cd007030.pub3

Young, C. A., Mills, R. P., Cj, G., & Ew, T. (2013b). Poststroke Fatigue: the Patient perspective. *Topics in Stroke Rehabilitation*, *20*(6), 478–484. https://doi.org/10.1310/tsr2006-478

1.9 Appendix A

1.9.1 Author guidelines for submission to the Journal of Neuropsychological Rehabilitation.

Instructions for authors

Thank you for choosing to submit your paper to us. These instructions will ensure we have everything required so your paper can move through peer review, production, and publication smoothly. Please take the time to read and follow them as closely as possible, as doing so will ensure your paper matches the journal's requirements.

AUTHOR SERVICES
Supporting Taylor & Francis authors

For general guidance on every stage of the publication process, please visit our Author Services website.

EDITING SERVICES
Supporting Taylor & Francis authors

For editing support, including translation and language polishing, explore our Editing Services website

SCHOLARONE MANUSCRIPTS™

This journal uses ScholarOne Manuscripts (previously Manuscript Central) to peer review manuscript submissions. Please read the guide for ScholarOne authors before making a submission. Complete guidelines for preparing and submitting your manuscript to this journal are provided below.

This title utilises format-free submission. Authors may submit their paper in any scholarly format or layout. References can be in any style or format, so long as a consistent scholarly citation format is applied. For more detail see the format-free submission section below.

Structure

Your paper should be compiled in the following order: title page; abstract; keywords; main text introduction, materials and methods, results, discussion; acknowledgments; declaration of interest statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list).

Word Limits

Please include a word count for your paper. There are no word limits for papers in this journal.

Style Guidelines

Please refer to these quick style guidelines when preparing your paper, rather than any published articles or a sample copy.

Please use American spelling style consistently throughout your manuscript. Please use single quotation marks, except where 'a quotation is "within" a quotation'. Please note that long quotations should be indented without quotation marks.

Alt Text

This journal is now including Alt Text (alternative text), a short piece of text that can be attached to your figure to convey to readers the nature or contents of the image. It is typically used by systems such as pronouncing screen readers to make the object accessible to people that cannot read or see the object, due to a visual impairment or print disability. Alt text will also be displayed in place of an image, if said image file cannot be loaded. Alt Text can also provide better image context/descriptions to search engine crawlers, helping them to index an image properly. To include Alt Text in your article, please follow our Guidelines.

Format-Free Submission

Authors may submit their paper in any scholarly format or layout. Manuscripts may be supplied as single or multiple files. These can be Word, rich text format (rtf), open document format (odt), or PDF files. Figures and tables can be placed within the text or submitted as separate documents. Figures should be of sufficient resolution to enable refereeing.

- There are no strict formatting requirements, but all manuscripts must contain the essential elements needed to evaluate a manuscript: abstract, author affiliation, figures, tables, funder information, and references. Further details may be requested upon acceptance.
- References can be in any style or format, so long as a consistent scholarly citation format is applied. Author name(s), journal or book title, article or chapter title, year of publication, volume and issue (where appropriate) and page numbers are essential. All bibliographic entries must contain a corresponding in-text citation. The addition of DOI (Digital Object Identifier) numbers is recommended but not essential.
- The journal reference style will be applied to the paper post-acceptance by Taylor & Francis.
- Spelling can be US or UK English so long as usage is consistent.

Note that, regardless of the file format of the original submission, an editable version of the article must be supplied at the revision stage.

1.9.2 Search Strategy

Table 1.4

Search terms used in Web of Science

Key concepts relating to inclusion criteria	Search terms
Phenomenon of interest/population	stroke* OR ischemic OR haemorrhag* OR infarct* OR cerebrovascular AND
Phenomenon of interest/population	fatigue OR "chronic fatigue" OR exhaustion AND
Intervention	qualitative OR "personal experience*" OR interview* OR "lived experience*" OR perception*

Table 1.5

Subject terms used in PsycINFO.

Key concepts relating to inclusion criteria	Subject terms
Phenomenon of interest/population	"cerebrovascular accidents" OR "cerebral infarction" AND
Phenomenon of interest/population	"fatigue" OR "chronic fatigue syndrome" OR "emotional exhaustion" AND
Intervention	"qualitative methods" OR "semi-structure interview" OR "structured clinical interview" OR "interview" OR perception

Table 1.6

Subject terms used in CINAHL.

Key concepts relating to inclusion criteria	Subject terms
Phenomenon of interest/population	"stroke" OR "ischemic stroke" OR "hypoxia-ischemia-brain" OR "hemorrhage" OR "infarction" OR "cerebral infarction" AND
Phenomenon of interest/population	"fatigue" OR "fatigue syndrome, chronic" OR "emotional exhaustion"

	AND
Intervention	“qualitative studies” OR “semi-structure interview” OR “unstructured interview” OR “structured interview” OR “interview” OR “perception”

Table 1.7

Subject terms used in Medline.

Key concepts relating to inclusion criteria	**Subject terms**
Phenomenon of interest/population	“stroke” OR “ischemic stroke” OR “cerebral infarction” OR “infarction” OR “brain infarction”
	AND
Phenomenon of interest/population	“fatigue” OR “fatigue syndrome, chronic” OR “emotional exhaustion”
	AND
Intervention	“qualitative research” OR “interviews as topic” OR “perception”

Chapter 2 Cognitive Behavioural Therapy for Post Brain Injury Fatigue: a single case experimental design

This chapter is written as a manuscript excluding the formal title page, for the Journal of Neuropsychological Rehabilitation (see Appendix B for author guidelines).

2.1 Abstract

This study evaluated the efficacy of a cognitive behavioural therapy (CBT) intervention for post-brain injury fatigue (PBIF) in four individuals (n=4) with acquired brain injury (ABI). Moreover, the study examined which components of a CBT intervention for PBIF can be most effective. The study used a withdrawal/reversal single-case experimental design (SCED). Participants attended a brief CBT intervention consisting of six sessions. Following an assessment, participants attended a formulation/psychoeducation session, two sessions introducing behavioural techniques and a session on cognitive restructuring. The final session focused on consolidating participants' knowledge. Participants' fatigue levels were measured on four occasions throughout the intervention using the Modified Fatigue Intensity Scale (MFIS) and the Visual Analogue Scale for Fatigue (VAS-F). A 10-point Likert scale was used to measure participants' daily fatigue levels. Participants' depression and anxiety symptoms were also measured using the Patient Health Questionnaire (PHQ-9) and the Generalised Anxiety Disorder (GAD-7) questionnaire respectively. Participants' overall perception of health was measured by the Short Form-36 (SF36) pre and post intervention. Our findings suggest that the CBT intervention was effective in reducing participants' fatigue symptoms. Participants experienced significantly less fatigue and higher energy levels post-treatment, as evidenced in their fatigue outcome measures. Findings suggest formulation/psychoeducation to be the most effective component of the entire CBT intervention. Most of the participants experienced improvements in their overall health perception and depressive symptoms. Clinical implications and directions for future research are discussed.

2.1.1 Keywords

Post-brain Injury Fatigue (PBIF), Acquired Brain Injury (ABI), Cognitive Behavioural Therapy (CBT)

2.1.2 Main text word count (excluding tables and figures): 9,942.

2.2 Introduction

Acquired Brain injury

Acquired Brain Injury (ABI) is a major public health problem and a major cause of morbidity and mortality across age groups, with 50 million new cases each year worldwide (Xu et al., 2021). ABI is a prevalent neurological condition, impacting circa 200 per 100,000 people globally (Jones et al., 2011). In the UK, data from 2019-20 suggests that there is one admission to hospital for brain injury every 90 minutes, one admission for head injury every three minutes, and one admission for stroke every four minutes (Headway, 2019). There has been an increase in all types of ABI by 12% since 2005-06, with the number of overall admissions to hospital being 356,699 in 2019-20 (Headway, 2019).

Fatigue Following Brain injury

Fatigue is a common symptom in patients with ABI with a prevalence of 43% to 73% (Belmont et al., 2006). Post brain injury fatigue (PBIF) has been found to occur for a long-time following hospital discharge and there is evidence to suggest that fatigue can often become a chronic condition (Stuart et al., 2012). A significant proportion of patients experience fatigue six or more years after a brain injury, impacting their participation in rehabilitation programmes and daily activities (Ponsford et al., 2014). Pre-morbid/early fatigue, mental health issues, medical conditions and ongoing societal factors can prolong the experience of PBIF (Mollayeva et al., 2014). However, despite the high prevalence of fatigue in ABI patients, the underlying causal factors and potential treatment options have not been thoroughly investigated (Zgaljardic et al.,2014). PBIF and its associations with psychiatric, sleep, cognitive, and psychosocial sequalae also remains poorly understood (Schiehser et al., 2016).

What is PBIF?

PBIF refers to fatigue that occurs secondary to brain injury, which is generally viewed and described as a manifestation of ‘central fatigue’ (Xu et al., 2017). Central fatigue is increasingly used in the literature to describe PBIF which denotes a central nervous system origin (Chaudhuri & Behan, 2004). It is described as “*the failure to initiate and/or sustain attentional tasks and physical activities requiring self-motivation as opposed to external motivation*” (Chaudhuri & Behan, 2000). Similarly, Aaronson et al. (1999) suggested that central fatigue involves the “*awareness of a decreased capacity for physical and/or mental activity due to an imbalance in the availability, utilisation and/or restoration of resources needed to perform activity”.* This type of fatigue is secondary to neurological insult or illness and is distinct to peripheral fatigue which occurs when the contractile strength of muscle fibres decreases (Tornero-Aguilera et al., 2022).

Central fatigue could be a useful term in the endeavour to conceptualise the multiple dimensions and consequences of fatigue post-ABI (Leavitt & DeLuca, 2010). However, there is little consensus on the definition of PBIF itself, as this type of fatigue involves a multidimensional motor-perceptive, emotional, and cognitive experience (De Doncker et al., 2017). Distinguishing between the phenomenon of fatigue and its impact on survivors, adds to the complexity of its definition (De Doncker et al., 2017). Defining and measuring PBIF in an objective manner is also a challenging task as PBIF can be experienced as physical and/or cognitive/mental, as well as have many different neurobiological and neurophysiological correlates (Rönnbäck & Johansson, 2022). As a clinical symptom, PBIF is difficult to distinguish from comorbid conditions such as sleep dysfunction and depression (Tomar et al., 2018).

Although measures of fatigue have been developed, there is no scale that serves as the gold standard measure for fatigue (Cantor et al., 2013). Establishing clear links between the subjective experience of PBIF and objective measurements has also proven to be a challenging task (DeLuca, 2005). This might explain why PBIF has not been adequately characterized, assessed, and managed (Wylie & Flashman, 2017). Subjective fatigue is difficult to understand as it is not a unitary construct, but a multidimensional concept, which can be influenced by many other factors such as sleepiness, psychopathology, and medication effects (Leavitt & DeLuca, 2010). However, evidence suggests that sleepiness and fatigue are not the same symptom as they arise from different neural mechanisms (DeLuca, 2005). Despite the frequent association with sleepiness, PBIF is described as a distinct state which is not necessarily linked with a need for sleep or even relieved by a period of sleep (Levine & Greenwald, 2009). Therefore, sleep serves a restorative function whereas fatigue has a vague biological role (Leavitt & DeLuca, 2010).

What causes PBIF?

The development of PBIF has been proposed to involve many different biological factors and there is still little known about the associated clinical, behavioural, and physiological components (Mollayeva et al., 2014).

Fatigue due to structural damage

Structural damage to the brain disrupts normal functioning and leads to alterations in the high-speed neural connections, requiring increased effort for information processing and more cognitive resources for task completion (Wylie & Flashman, 2017). Subsequently, completion of tasks which may require more cognitive resources make the brain more prone to cognitive fatigue (Van Zomeren et al., 1984). Slowed processing speed and attentional difficulties resulting from structural damage, can also contribute to cognitive overload (Belmont et al., 2006). Therefore, the brain needs to exert more energy to perform the same cognitive tasks and is constantly working harder to compensate.

fMRI studies have demonstrated a link between traumatic brain injury symptoms and increased activation in attentional brain areas, such as the anterior cingulate cortex (ACC) and decreased activation in the default mode network (Dean et al., 2014). Wylie et al. (2015) have shown that brain injured individuals' default network is less activated than healthy controls, suggesting they must work harder to compensate. Shumskaya et al. (2012) found more activity in the dorsolateral prefrontal cortex (and less functional connectivity in the motor network) suggesting motor slowing and the need for more attentional resources in ABI. Moreover, although McAllister et al. (1999) found greater brain activation during performance of a working memory task in brain injured individuals as opposed to controls, their findings also support the idea that individuals with ABI seem to work harder to appropriately modulate their processing resources. Dobryakova et al. (2013) have also found evidence to support that PBIF can be associated with disruptions in the cortico-striatum network (i.e. basal ganglia projections to the prefrontal cortex), which can lead to an 'effort-reward imbalance'. That is, that clinical populations fail to exert effort to obtain a rewarding outcome during periods of significant fatigue, interpreting increased effort expenditure as subjective fatigue.

Role of the pituitary gland in PBIF

The pituitary gland is a pea-sized structure which weights approximately 600mgs and sits within the sella turcica cranial area. It is connected to the hypothalamus, a brain region responsible for coordinating and maintaining homeostasis in the body (Masel et al., 2015). ABI can disrupt those connections and lead to post-traumatic hypopituitarism (PTH) and hormone imbalance, which can cause fatigue. Aimaretti et al. (2004) found a prevalence of 32.8% in PTH in the first 3 months post brain injury in ABI patients, highlighting the need for differential diagnosis of PBIF.

Metabolic changes after ABI and impact on cognitive function

The brain plays a fundamental role in regulating endocrine processes through interactions among neurohormones. Therefore, it is anticipated that any functional changes and/or structural damage following an ABI can result in endocrine changes which affect the whole system (Li & Sirko, 2018). A large proportion of ABI patients present with memory and concentration difficulties, depression, fatigue, and loss of emotional well-being, which are all symptoms that resemble endocrine disorders, such as hypothyroidism (Hellawell et al., 1999). ABI's impair mitochondrial functioning resulting in an 'energy crisis' due to changes in glucose metabolism (Verweij et al., 2000). Limited glucose supplies in the bloodstream can cause fatigue, whereas increased glucose levels can enhance endurance and maintain stamina (Coyle et al., 1993).

Neuroinflammation in the brain

Structural damage to the brain following ABI provokes biochemical events which initiate the death of brain cells and exacerbate the primary injury (Feiger et al., 2022). Following this, metabolic and cellular changes induce excitotoxicity, oxidative stress, cause mitochondrial dysfunction, disruption to the blood-brain barrier, and neuroinflammation (Lozano et al., 2015). Neuroinflammation initiated straight after ABI seems to have two effects; a neuroprotective effect, to save the brain from further damage, but also a harmful effect, as excessive neuroinflammatory activation leads to the toxic accumulation of cytokines which contribute to further cellular death (Feiger et al., 2022). ABI survivors can develop chronic inflammation which can last for years after their injury (Gentleman et al., 2004). Inflammatory cytokines seem to play a vital role in the genesis and maintenance of PBIF (Wen et al., 2018).

Impact of PBIF

PBIF is one of the most disabling symptoms regardless of the severity of the brain injury (Belmont et al., 2006). PBIF is a debilitating, distressing and often chronic symptom affecting peoples' physical, cognitive, social, and emotional functioning (Raina et al., 2022). It negatively influences ABI survivors' health related quality of life and hinders their mental speed, attention, memory, working memory, and communication (Åkerlund et al., 2021). Worthington et al. (2017) found that PBIF affects activities of daily living, such as shopping and using transport, due to the effort and energy required to carry out these activities. Brett et al. (2015) also found that PBIF impact's ABI survivors' ability to engage with rehabilitation programmes requiring therapists to adopt strategies to manage it during therapy. Moreover, PBIF often affects the lives of families and carers of ABI survivors' as it limits their social life resulting in increased loneliness and isolation (Ablewhite et al., 2022). PBIF can simultaneously interfere with, and be exacerbated by, engagement in physical and cognitive activities, and as result, restricts participation in activities of daily living, social engagement, and occupational functioning (Ali et al., 2021). PBIF significantly impacts on the well-being and quality of life of ABI survivors and cannot be accounted for by depression, pain, and sleep disturbances alone, but is instead a direct consequence of brain injury itself (Cantor et al., 2008).

Cognitive behavioural therapy for PBIF

Following ABI, patients may experience subsequent cognitive, emotional, behavioural, and social difficulties which can hinder engagement with treatment and daily activities (Gómez-De-Regil et al., 2019). The aetiology of PBIF is complex, as it is a multidimensional syndrome that includes physical, but also psychological, motivational, situational, and activity-related components (Xu et al., 2017). Psychological interventions can be promising in treating PBIF as psychological factors are the most reported comorbidities of PBIF (Wu et al., 2017).

Cognitive behavioural interventions are psychological approaches that educate patients and provide the cognitive and behavioural skills to function adaptively in their interpersonal and intrapersonal worlds (Xu et al., 2017). There is evidence to suggest that cognitive behavioural therapy (CBT) can be effective in the management of PBIF (Cantor et al., 2014). Raina et al. (2022) found that an online CBT-based intervention using problem solving and energy conservation techniques was effective in reducing PBIF, opposed to an online educational intervention informing participants on diet, exercise, and energy conservation only. Therefore, CBT-informed techniques were more effective in reducing the impact of PBIF compared to education alone. Similarly, Ymer et al. (2021) compared CBT for PBIF to a health education intervention. Researchers found CBT to be effective in reducing patients' fatigue at all time points, a result not evident for the health education intervention. This study's findings suggest that reduction in PBIF levels was achieved when both an understanding of PBIF and strategies for its management were introduced to ABI patients.

Further evidence has been provided by Nguyen et al., (2017) who found that a CBT for insomnia intervention significantly reduced ABI patients' fatigue as opposed to treatment as usual (TAU). These researchers developed and tested a pilot study for sleep disturbance and fatigue in patients with ABI by adapting previous manuals for chronic fatigue syndrome and including core CBT principles (e.g., psychoeducation, behavioural activation, cognitive restructuring, relaxation, and relapse prevention). Following therapy, these participants reported significantly less daily fatigue equivalent to a large treatment effect. It appeared that adapted CBT produced greater and more sustained improvements in daily fatigue levels, compared with treatment as usual. The study findings suggest that therapy adaptions are necessary to achieve a reduction in PBIF levels among ABI patients.

Contradictory findings have also been reported for the effectiveness of CBT for the management of PBIF in ABI survivors. A recent systematic review evaluated the efficacy of nine studies which utilised a range of CBT-based interventions (including psychoeducation, pacing and behavioural activation) for the management of PBIF (Ali et al., 2021). Results suggested mixed evidence for the effectiveness of CBT as only two studies reported reduction in ABI patients' fatigue levels. However, out of the nine studies only two studies used the same outcome measures to measure participants' experience of PBIF and only a few studies reported their CBT protocol and fidelity checks.

Dismantling CBT therapy

Psychological interventions based on CBT principles have been proven to be effective in the management of various psychological difficulties, suggesting that the evidence base for CBT is very strong (Hofmann et al., 2012). CBT can be offered remotely and/or in person and evidence suggests that both forms of delivery are effective (Cuijpers et al., 2010) which is similar for multimedia and hybrid CBT (López-López et al., 2019). Historically, research has focused on the effectiveness of CBT as a therapy “package” which includes multiple CBT-components, rather than the efficacy of the distinct CBT components (Van Den Heuvel et al., 2019). As a result, little is known about which specific CBT components contribute to the effectiveness of CBT interventions. This knowledge could contribute to the development of new recommendations and guidelines to optimise and offer brief CBT interventions with more effective outcomes in future. This importance of this becomes more evident in the current UK National Health Service (NHS) environment. Research suggests that the NHS has been under unbearable strain: 24 NHS trusts have declared “critical incident” in 2022, and data suggests that 10,000 people waited 5 times longer than in 2020 and 9 times longer than in 2019 for an appointment (Alderwick, 2022).

Aim of the current study

Considering the mixed results on the efficacy of CBT for PBIF, there is a clear need to re-investigate the effectiveness of CBT for the management of fatigue among ABI patients. Based on the fatigue management CBT protocol adapted and tested for ABI patients by Nguyen et al. (2017), the current study adapted and administered a CBT intervention programme for ABI patients experiencing PBIF.

The primary aim of this study was to establish the effectiveness of a cognitive behavioural intervention on the management of PBIF. The secondary aim was to examine which components of a CBT intervention can be most effective in the management of PBIF.

2.3 Methods

2.3.1 Design

This study used a withdrawal/reversal (A1, B1, A2, B2, A3, B3, A4) single-case experimental design (SCED). See Figure 2.1 for more information.

There are multiple reasons for choosing this type of methodology for this study. SCED is a flexible, rigorous, and cost-effective approach which can help identify the optimal treatment for an individual patient (Epstein & Dallery, 2022). In addition, SCEDs can enable researchers to investigate which part of a treatment is most effective. Choosing this type of design, researchers were able to address the research questions of this study. SCEDS allows for high quality research to be conducted in clinical settings with small and heterogenous populations (Krasny-Pacini & Evans, 2018). All participants of this study suffered a brain injury constituting a very heterogenous population.

SCEDs are less impacted by recruitment problems as one to three subjects is enough to draw reliable conclusions regarding the effectiveness of a treatment (Graham et al., 2012). Following NHS ethics’ approval, the research team was able to recruit four participants to take part in this study.

SCEDs allow researchers to study participants more intensely and comprehensively as the power of this type of methodology comes from the number of repeated measures and not from the number of participants. All participants completed outcome measures on four occasions (in addition to the daily fatigue ratings), allowing researchers to comprehensively study participants' fatigue levels at various timepoints and test the efficacy of the CBT intervention.

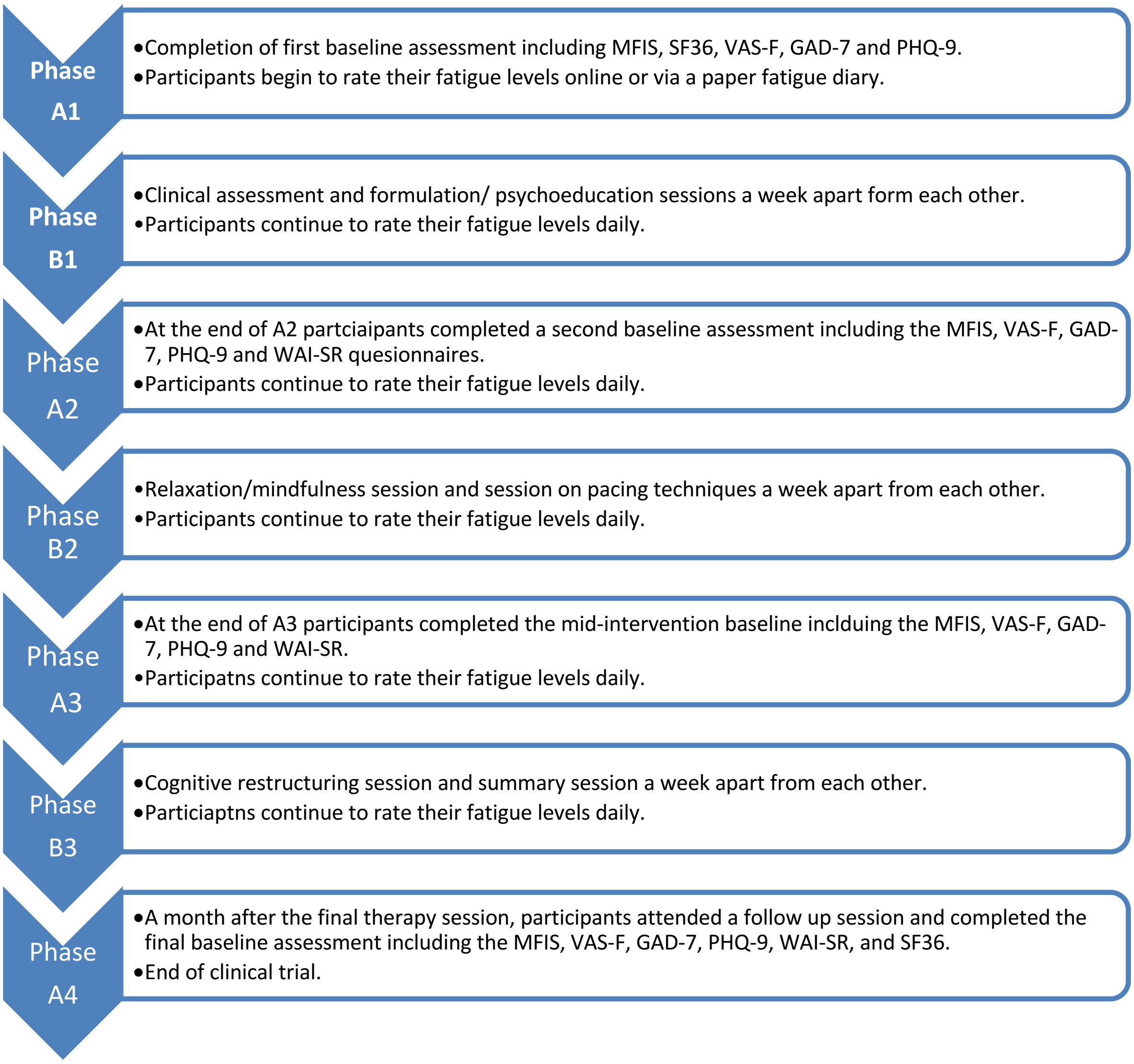
SCEDs allow an intervention to be tailored to the specific needs of an individual and to assess its effectiveness through rigorous methodology and detect the effect of the intervention within the large variability of a participant's performance (Krasny-Pacini & Evans, 2018). The research team aimed to evaluate the efficacy of a brief CBT intervention for the management of PBIF. Although relying on a pre-existing protocol used by Nguyen et al. (2017), the research team piloted a modification of this known intervention to further assess the efficacy of CBT for PBIF aiming to add to its evidence base.

Finally, this type of methodology was deemed appropriate due to time and resource constraints. The study constituted a doctorate thesis project, which needed to be completed within a specific time period and was limited with funding, which would not allow the recruitment of a larger sample of participants to form a randomised controlled trial.

For the reasons described above, SCED was selected for this study. Despite the multiple advantages of this design however, SCEDs come are various limitations. This is further discussed in the limitations of this study.

Figure 2.1

Flow-chart of intervention



Phase A1

- Completion of first baseline assessment including MFIS, SF36, VAS-F, GAD-7 and PHQ-9.
- Participants begin to rate their fatigue levels online or via a paper fatigue diary.

Phase B1

- Clinical assessment and formulation/ psychoeducation sessions a week apart form each other.
- Participants continue to rate their fatigue levels daily.

Phase A2

- At the end of A2 partciaipants completed a second baseline assessment including the MFIS, VAS-F, GAD-7, PHQ-9 and WAI-SR quesionnaires.
- Participants continue to rate their fatigue levels daily.

Phase B2

- Relaxation/mindfulness session and session on pacing techniques a week apart from each other.
- Participants continue to rate their fatigue levels daily.

Phase A3

- At the end of A3 participants completed the mid-intervention baseline inclduing the MFIS, VAS-F, GAD-7, PHQ-9 and WAI-SR.
- Participatns continue to rate their fatigue levels daily.

Phase B3

- Cognitive restructuring session and summary session a week apart from each other.
- Particiaptns continue to rate their fatigue levels daily.

Phase A4

- A month after the final therapy session, participants attended a follow up session and completed the final baseline assessment including the MFIS, VAS-F, GAD-7, PHQ-9, WAI-SR, and SF36.
- End of clinical trial.

Note: A1 was a 2-3-week baseline period, B1 was the first intervention phase, A2 was a 2-week withdrawal period, B2 was the second intervention phase, A3 was a 2-week withdrawal period, B3 was the third intervention phase and A4 a withdrawal 4-week period. Randomisation and blinding were not used.

2.3.2 Participants

Patients who sustained a brain injury and reported experiencing fatigue post injury were recruited from an Adult Community Brain Injury Rehabilitation service at a local NHS trust. Inclusion criteria were: (1) adults aged 18 and above and capable of giving informed consent, (2) sufficient English to engage in talking therapy, (3) not currently engaged in another psychotherapy, (4) a diagnosis of ABI, (5) self-reported experience of fatigue, and (6) no previous experience of CBT.

Exclusion criteria were severe post-ABI injuries resulting in difficulty in engaging in talking therapies including severe cognitive/communication impairments. Four patients were identified by the principal investigator of the study after referral screening, and all of them consented to take part in the study (see Table 1).

Table 2.1

Participants' demographics.

Participant	**1**	**2**	**3**	**4**
Sex	Female	Male	Female	Male
Age	54	55	42	36
Ethnicity	White British	White English	White South African	White English
Marital status	Single	Single	In a relationship	Married
ABI type	Haemorrhagic Stroke	Ischaemic Stroke	Ischaemic Stroke	TBI

2.4 Measures and Materials

The following measures and materials were completed/used throughout the clinical trial. Routine outcomes were completed during appointments, while daily fatigue ratings were completed by the participants independently.

Likert Scale to measure daily fatigue

Participants rated their fatigue levels daily using a 10-point Likert scale ranging from 0 (not fatigued at all) to 10 (total fatigue and exhaustion/nothing left) (Micklewright et al., 2017). Some participants submitted their daily fatigue ratings online via Lifeguide (a software research programme) whereas others completed written forms.

Psychometrics

To measure participants' fatigue levels, the **Modified Fatigue Impact Scale** was used (MFIS; Mills et al., 2010; Larson, 2013). This provides an assessment of the effects of fatigue in terms of physical, cognitive, and psychosocial functioning; the measure has 21 items rated on a 5-point scale (0=never, 1=rarely, 2=sometimes, 3=often and 4=always), with higher scores indicating greater impact of fatigue (Strober et al., 2020). The maximum score is 84 for the total score, 28 for the physical subscale, 40 for the cognitive subscale, and 8 for the psychosocial subscale. The scale has excellent internal consistency and good test–retest reliability (Raina et al., 2022).

To further evaluate participants' fatigue, the **Visual Analogue Scale of Fatigue Severity** (VAS-F) was used (Shahid et al., 2011). The scale consists of 18 items which measure the subjective experience of respondents' fatigue. Respondents read each item and choose the number that corresponds best to their experience along a visual analogue scale (from 0 to 10, with 0 meaning not at all tired and 10 extremely tired). The VAS-F has high internal consistency and reliability (Lee et al., 1991).

The Patient-Health Questionnaire 9 (PHQ-9) assesses symptoms of depression (Kroenke et al., 2001). The PHQ-9 consists of 9 items; every item can be scored on a scale of 0–3 (0 = not at all; 1=several days; 2=more than half the days; 3= nearly every day). Scores between 5-9, 10-14, 15-19, and 20-27 indicate mild, moderate, moderately severe, and severe symptoms of depression respectively. The PHQ-9 is a valid and reliable measure of depression severity (Kroenke et al., 2001).

The Generalised Anxiety Disorder 7 (GAD-7) assesses symptoms of anxiety in the last two weeks (Stocker et al., 2021). The GAD-7 consists of 7 items; every item can be scored on a scale of 0-3 (0=not at all; 1=several days; 2=more than half the days; 3=nearly every day). Scores between 5-9, 10-14 and >15 indicate mild, moderate, and severe anxiety respectively (Bischoff et al., 2020). The GAD-7 has had good reliability, as well as criterion, construct, factorial, and procedural validity (Spitzer et al., 2006).

Participants' overall health status was measured with the **Short Form 36 - Health Survey Questionnaire (SF-36)** (Burholt & Nash, 2011). The SF-36 is a 36 items scale which measures eight domains of functioning; physical functioning (10 items); physical role limitations (four items); bodily pain (two items); general health perceptions (five items); energy/vitality (four items); social functioning (two items); emotional role limitations (three items) and mental health (five items) (Ware & Sherbourne, 1992). Raw scores are converted into the eight dimensions with the use of a scoring algorithm and transformed on a percentage scale. Numbers close to 100 indicate good health in the relevant domain. The SF-36 fulfils stringent criteria of reliability and validity (Brazier et al., 1992).

In addition, participants completed the **Working Alliance Inventory-Short Revised (WAI-SR).** The WAI-SR is 12-item questionnaire which assesses the therapeutic alliance by capturing three key alliance aspects: agreement on the tasks of therapy, agreement on the goals of therapy, and development of an affective bond (Münder et al., 2009). The WAI-SR demonstrates very good internal consistency and validity (Münder et al., 2009).

Participants were also asked to provide some sociodemographic information about their ethnicity, age, type of brain injury, gender, and marital status.

2.5 Procedure

Initially, the Principal Investigator (Consultant Clinical Neuropsychologist for the service) identified potential candidates for the study based on referral and study inclusion/exclusion criteria. Patients were contacted by the Principal Investigator and informed about the nature and purpose of the study. Patients who gave verbal consent were then contacted by the Chief Investigator, who talked through the components of the study and asked for their consent to engage. Participants signed a consent form, completed the first baseline assessment (either in person or online via Lifeguide), and provided routine fatigue measures (daily submission of their fatigue levels for the rest of the intervention). Following this, participants engaged in the intervention (see Table 2). Participants were reminded to fill out fatigue rating forms or rate their fatigue on Lifeguide throughout the intervention. At the end of the intervention, participants were debriefed (see Appendix B) and discharged from the service.

2.5.1 Intervention

The therapeutic intervention consisted of the following sessions (see Table 2.2).

Table 2.2

Overview of the CBT intervention for fatigue management after brain injury.

Session number	Content	Homework Exercises	Type of CBT intervention
Session 1	Clinical Interview	N/A	Assessment
Session 2	Biopsychosocial Formulation/ Psychoeducation on PBIF	N/A	Formulation
Session 3	Relaxation and mindfulness techniques.	Breathing exercises/mindfulness techniques.	Behavioural Intervention

Session number	Content	Homework Exercises	Type of CBT intervention
	Breathing exercises and mindfulness techniques (5,4,3,2,1 exercise and visualisation exercise).		
Session 4	Pacing Activities and Prioritisation of energy resources.	Activity diary/ identification of high/amber and low expenditure activities.	Behavioural Intervention
Session 5	Cognitive restructuring	Identification of negative thinking styles, cognitive restructuring activity	Cognitive Intervention
Session 6	Summary session	Consolidation of knowledge	Cognitive/Behavioural Intervention
Follow-up session	Completion of questionnaires	N/A	N/A

The first intervention phase (B1) included a psychological assessment aiming to assess the impact of fatigue on participants' cognitive, physical, and emotional functioning (session 1), and the development of a collaborative biopsychosocial formulation including psychoeducation on the nature of PBIF (session 2). The biopsychosocial formulation considered predisposing, precipitating, and perpetuating factors which contributed to participants' fatigue, but also helpful strategies which enabled them to manage its consequences to date (Kusnanto et al., 2018).

The second intervention phase (B2) focused on behavioural interventions including relaxation/mindfulness and pacing (sessions 3 and 4 respectively). The relaxation and mindfulness session aimed to provide participants with an evidence-based rationale to practise these relaxation/mindfulness strategies (Mikolasek et al., 2017). Session 4 focused on the benefits of pacing and prioritising energy resources (Guy et al., 2019).

The third and final intervention phase (B3) included a cognitive restructuring session (session 5), aiming to provide participants with techniques that can help them shift their negative thinking styles (Marasigan, 2019) and a summary session (session 6), aiming to consolidate participants learning and support participants' meta-cognitive skills, such as being able to recognise when to use certain strategies.

The intervention was provided by a third-year Trainee Clinical Psychologist trained in CBT, under the supervision of two Clinical Neuropsychologists and a Cognitive Behavioural Therapist. The trainee clinical psychologist had previously received CBT training as part of their doctorate, completed a Low Intensity CBT post-graduate programme, and attended a two-day masterclass in CBT for insomnia.

2.6 Data Analysis

2.6.1 Reliable Change Index (RCI)

The Reliable Change Index (RCI) calculates the likelihood of an observed change whilst considering the extent of measurement error; when RCI exceeds 1.96, this indicates a significant change has occurred ($p< .05$) (Wise, 2004). Researchers chose RCI to compare participants' baseline scores on the psychometric battery of questionnaires to other timepoints throughout the intervention (Jacobson & Truax, 1991). Researchers did not aim for non-clinical scores on outcome measures due to the potential crossover between psychological distress and physical limitations/difficulties (Kelly et al., 2006).

2.6.2 Visual analysis

For each participant, daily fatigue ratings were plotted graphically for visual analyses. Visual analyses were conducted following recommendations from Ledford and Gast (2014). To indicate changes in the average fatigue scores between the different intervention phases, horizontal lines showing the average fatigue rating for each phase were used. The trend was determined by the slope and direction of the best fitting straight line for each phase (Rauwenhoff et al., 2022). To calculate this, we used the Split Middle Method (Ledford and Gast, 2014). Trend stability was defined by a stability window ±25% of the trend line (Ledford et al., 2017).

2.6.3 Non-overlap of all pairs (NAP)

Non-overlap of all pairs (NAP) was used to measure the effect size of the intervention compared to baseline (Rauwenhoff et al., 2022). As all participants had sustained an ABI more than six months prior to engaging with therapy, we did not expect spontaneous improvements in the baseline phase. The use of NAP is therefore an appropriate measure to use compared to baseline-corrected TAU (Fingerhut et al., 2021). An online calculator was used to calculate NAP (Tarlow, 2016). A 0.20 improvement indicates a small change in effect size, 0.20 to 0.60 a moderate change, 0.60 to 0.80 a large change and above 0.80 a large to very large change (Tate & Perdices, 2019).

2.6.4 Ethics

Ethical approval was received from the Ethics and Research Governance at University of Southampton (ID 80267) and the NHS Health Research Authority (ID 326412, see Appendix B). The study was registered as a clinical trial with ISTCTN (ISRCTN18810622).

2.7 Results

2.7.1 Feasibility

All participants completed the six therapy sessions and attended a follow-up session one month after the end of the clinical trial. Three participants rescheduled 40% of their appointments due to experiencing fatigue. As a result, every participant's treatment timeline was slightly different. Two participants reported their fatigue ratings throughout the intervention daily with a 100% response rate. The other two participants' response rate ranged from 80-90% despite constant reminders. As a result, the intervention was considered feasible for ABI patients.

2.7.2 Safety

No adverse events were reported by participants throughout the intervention.

2.7.3 Acceptability

No participant dropped out once they started with therapy, suggesting that the intervention was acceptable. All participants reported that they benefited from therapy and provided positive feedback at the follow-up session. All participants expressed that they had a much better understanding of their fatigue and were using the techniques they had learnt during their appointments. They also expressed that they would be interested in additional sessions.

2.7.4 Fidelity checks

At least 30% of sessions for each participant were randomly recorded and rated against the Manual of the Revised Cognitive Therapy Scale (CTS-R) (Blackburn et al., 2001) by an accredited-CBT therapist. CTS-R scores were high for all marked sessions with a minimum score of 36. Therefore, the intervention demonstrated good fidelity to CBT.

2.7.5 Effectiveness

An analysis of the effectiveness of the intervention was provided using the routine outcome measures (i.e. reliable change index) and daily fatigue ratings (e.g. phase characteristics, visual analyses, Tau-U statistics) for each participant.

2.7.6 Reliable Change Index

All participants showed significant improvements in their fatigue from the baseline to follow-up phase (see Table 3). This is discussed further for each participant below.

Table 2.3

Reliable Change Index.

Outcome measure	Participant 1	Participant 2	Participant 3	Participant 4
PHQ-9				
Baseline	11	11	11	11
Baseline – Second Baseline	12(0.56)	9 (-1.12)	14(1.68)	16(2.81*)
Baseline - Mid-intervention	15(2.24*)	10(-0.56)	4(-3.93*)	20(5.05*)
Baseline – Follow Up	9(-1.12)	7 (-2.24*)	1(-5.61*)	6(-2.81*)
GAD-7				
Baseline	8	8	8	8
Baseline – Second Baseline	8(0.00)	15(2.45*)	10(0.70)	17(3.15*)
Baseline – Mid-intervention	14(2.10*)	12 (1.40)	3(-1.75)	21(4.55*)
Baseline-F/Up	11(1.05)	8 (0.00)	1(-2.45*)	8(0.00)
SF36				
Baseline	35	35	35	35
Baseline-F/Up General Health Perception	40(0.36)	82 (3.36*)	92(4.07*)	62(1.93)
Baseline	50	50	50	50
*Baseline-F/Up** Change in Health*	100	100	75	75
Baseline	60	60	60	60
Baseline-F/Up Physical Functioning	55(-0.49)	80(1.95)	95(3.41*)	85(2.44*)
Baseline	0	0	0	0
Baseline-F/Up Role Limitation Physical	0(0.00)	100(4.34*)	100(4.34*)	75(3.25*)
Baseline	100	100	100	100
Baseline-F/Up Role Limitation Emotional	33.33(-2.81*)	33.33(-2.81*)	100(0.00)	100(0.00)
Baseline	22.22	22.22	22.22	22.22
Baseline-F/Up Social Functioning	22.22(0.00)	66.66(3.19*)	100(5.58*)	77.77(3.99*)
Baseline	11.11	11.11	11.11	11.11
Baseline-F/Up Pain	44.44(1.96*)	55.55(2.63*)	88.88(4.61*)	77.77(3.95*)
Baseline	44	44	44	44
Baseline-F/Up Mental Health	64(2.03*)	52(0.81)	80(3.66*)	80(3.66*)
Baseline	35	35	35	35
Baseline-F/Up Energy/Vitality	45(0.84)	60(2.11*)	90(4.64*)	50(1.27)
MFIS total				
Baseline	61	61	61	61
Baseline – Second Baseline	58(-0.41)	51(1.36)	42(-2.58*)	71(1.36)

Outcome measure	**Participant 1**	**Participant 2**	**Participant 3**	**Participant 4**
Second assessment-Mid-intervention	42(-2.17*)	49(-0.27)	23(-2.58*)	72(0.14)
Baseline-Third Baseline	42(-2.58*)	49(-1.63)	23(-5.16*)	72(1.49)
Baseline-F/Up	41(-2.71*)	26(-4.75*)	17(-5.96*)	32(-3.94)
MFIS physical				
Baseline	26	26	26	26
Baseline – Second Baseline	24(-0.79)	24(-0.79)	18(-3.16*)	28(0.79)
Baseline-Mid-intervention	19(-2.77*)	23(-1.19)	9(-6.72*)	27(0.40)
Baseline-F/Up	20(-2.37*)	12(-5.53*)5	(-8.30*)	9(-6.72*)
MFIS cognitive				
Baseline	29	29	29	29
Baseline – Second Baseline	28(-0.52)	22(-3.64*)	20(-4.68*)	35(3.12*)
Baseline-Mid-intervention	18(-5.72*)	22(-3.64*)	12(-8.84*)	37(4.16*)
Baseline-F/Up	16(-6.76*)	11(-9.36*)	11(-9.36*)	21(-4.16*)
MFIS psychosocial				
Baseline	6	6	6	6
Baseline – Second Baseline	6(0.00)	5(-1.16)	4(-2.32*)	8(2.32*)
Baseline-Mid-intervention	5(-1.16)	4(-2.32*)	2(-4.64*)	8(2.32*)
Baseline-F/Up	5(-1.16)	3(-3.48*)	2(-4.64)	2(-4.64*)
VAS-F Fatigue				
Baseline	126	129	123	123
Baseline – Second Baseline	101(-3.15*)	63(-8.30*)	57(-3.15*)	114(-3.15*)
Baseline-Mid-intervention	48(-9.81*)	65(-8.05*)	16(-9.81*)	83(-9.81*)
Baseline-F/Up	37(-11.20*)	65(-8.05*)	9(-11.20*)	48(-11.20*)
VAS-F Energy				
Baseline	10	0	0	0
Baseline – Second Baseline	41(4.53*)	25(3.65*)	16(4.53*)	7(4.53*)
Baseline-Mid-intervention	33(3.36*)	24(3.51*)	25(3.36*)	5(3.36*)
Baseline-F/Up	26(2.34*)	26(3.80*)	21(2.34)	31(2.34*)

Note: PHQ-9=Patient Health Questionnaire 9, GAD-7=Generalised Anxiety Disorder 7, SF36= MOS 36-item short-form health survey (SF-36), MFIS=Modified Fatigue Impact Scale, VAS-F=Visual Analogue Scale-Fatigue.
*Significant results (> 1.96) with positive significant results indicated in green and negative in red.
**Only one question generates the outcome for this SF36 factor; RCI cannot be calculated (Ware & Sherbourne, 1992).

2.7.7 Participant 1

Participant 1 attended her appointments face-to-face in the service. The intervention duration was 3.53 months. Participant 1 presented with significant fatigue which was affecting her cognitive, emotional, and physical functioning. She felt very low and had been experiencing depression before her stroke. She was worrying about her health, her recovery, her family members, and their difficulties. Participant 1 had stopped going out, was avoiding activities and people and did not know how to manage her energy levels. Her unhelpful behaviours and negative thinking styles were maintaining the fatigue experience.

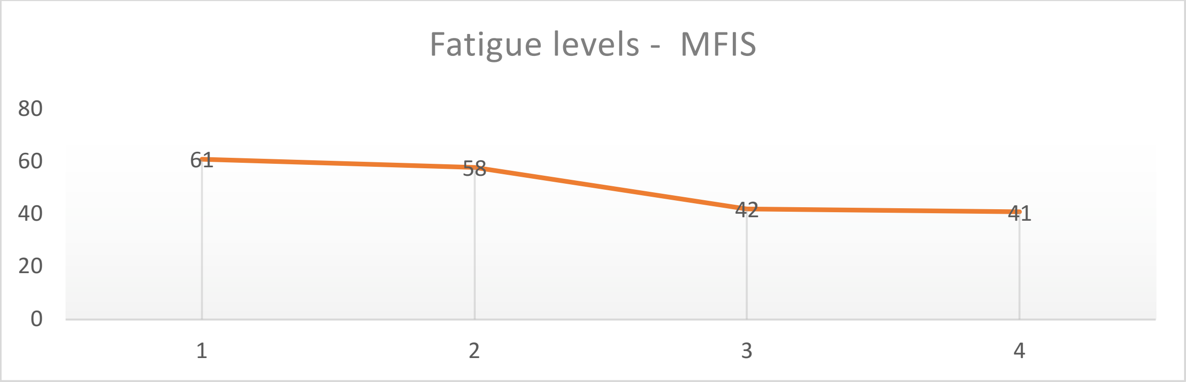
Reliable Change Index

Participant 1’s overall fatigue levels improved significantly after session four (pacing) of the intervention as evidenced in her MFIS scores. Her fatigue levels remained significantly low at the follow-up session with significant improvements in both her cognitive and physical fatigue (as evidenced in her MFIS scores). Participant 1’s fatigue and energy scores on the VAS-F showed significant improvements after the second session (formulation). Her fatigue levels dropped while her energy levels increased significantly (see Figures 2.2, 2.3, and 2.4).

Participants 1 did not show improvements in depression and anxiety complaints. Her depression and anxiety scores increased significantly (as evidenced in the second baseline assessment) but dropped to initial baseline levels at the end of treatment. In relation to her overall health (scores on SF-36), participant 1 showed significant improvements in her mental health and pain management pre and post treatment. Participants 1 reported that understanding PBIF in conjunction with knowing how to respond to its symptoms to be the most helpful components of the intervention.

Figure 2.2

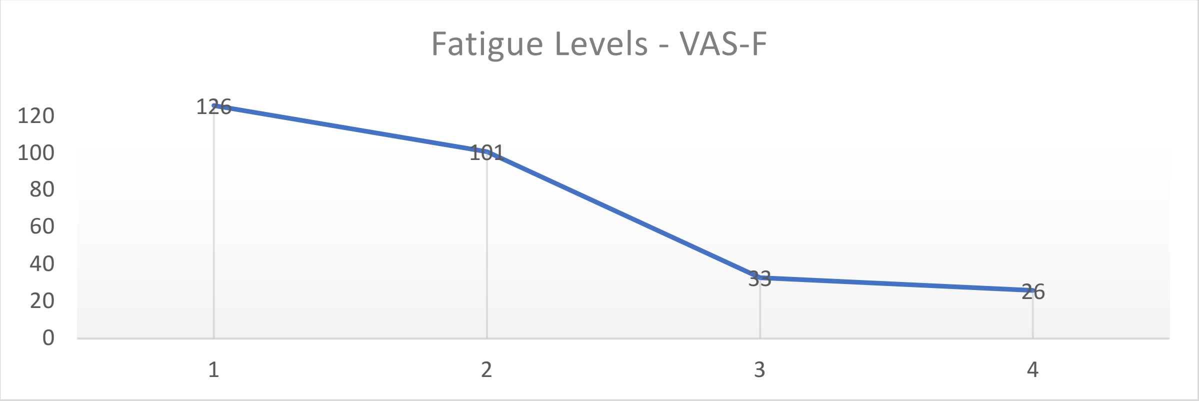
MFIS scores-Participant 1



Note: Fatigue scores on MFIS over time. Maximum score in the MFIS is 84 and lowest 0. A score of 84 would indicate extreme fatigue, whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicates first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.3

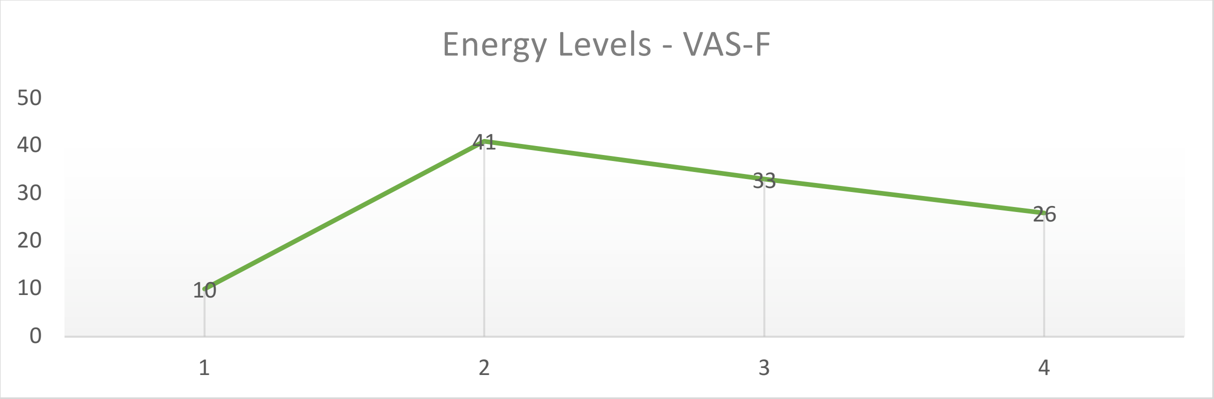
VAS-F fatigue scores-Participant 1



Note: Fatigue scores on VAS-F over time. Maximum score is 130 and lowest 0 (questions 1-5, and 11-18 cumulatively). A score of 130 would indicate extreme fatigue whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.4

VAS-F Energy scores- Participant 1



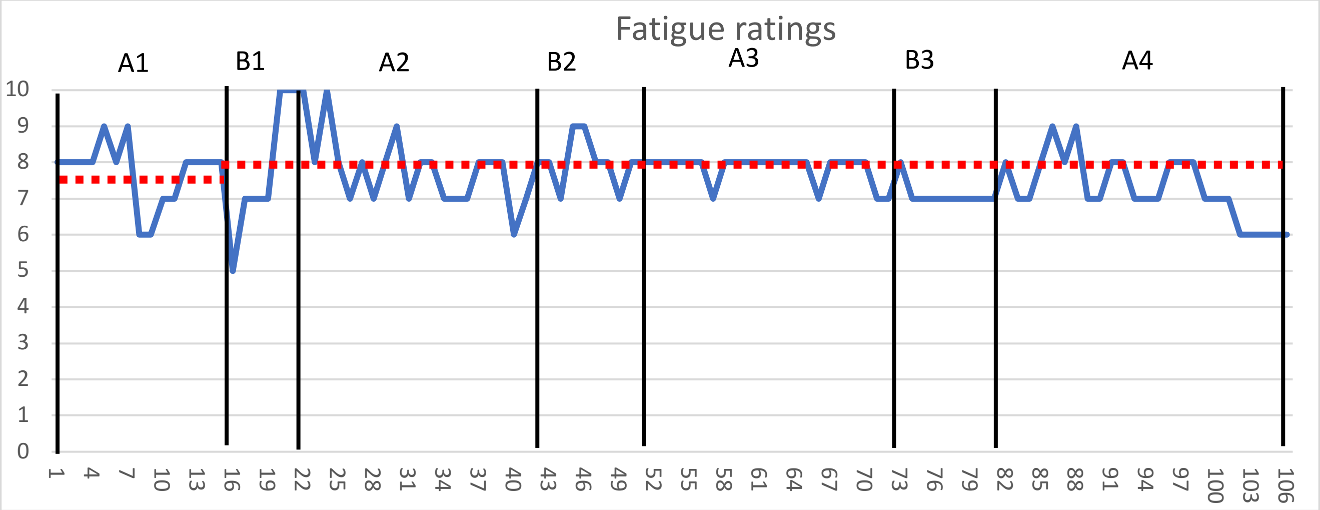
Note: Energy scores on VAS-F over time. Maximum score is 50 and lowest 0 (questions 6-10 of the VAS-F cumulatively). A score of 50 would indicate extreme energy, whereas a score of 0 would indicate no energy. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Visual Analysis

When daily fatigue scores were visually plotted, they remained within the stability window (±25% of the trend line) indicating a zero-*celerating* trend along the ordinate scale (Ledford et al., 2017). See Figure 2.5.

Figure 2.5

Daily fatigue ratings-Participant 1



Note: Daily fatigue ratings of participant 1 over time. The vertical straight lines indicate the start and end of phase of the intervention. The horizontal lines indicate the average score per phase. Average value of fatigue scores for the baseline=7.75, for the intervention=8.

Response to Intervention

There was no significant change between baseline and intervention:

Tau = 0.050, *p* = 0.588 (SE_{Tau} = 0.138) suggesting no difference in fatigue complaints.

2.7.8 Participant 2

Participant 2 attended his appointment face-to-face at the service. The intervention duration lasted 3.23 months. Participant 2 had lost three members of his family in the past and was going through bereavement prior to his stroke. He had a busy job prior to his stroke which involved travelling between cities. Since his stroke, participant 2 was experiencing fatigue and he was worrying about his finances, work situation, and his future.

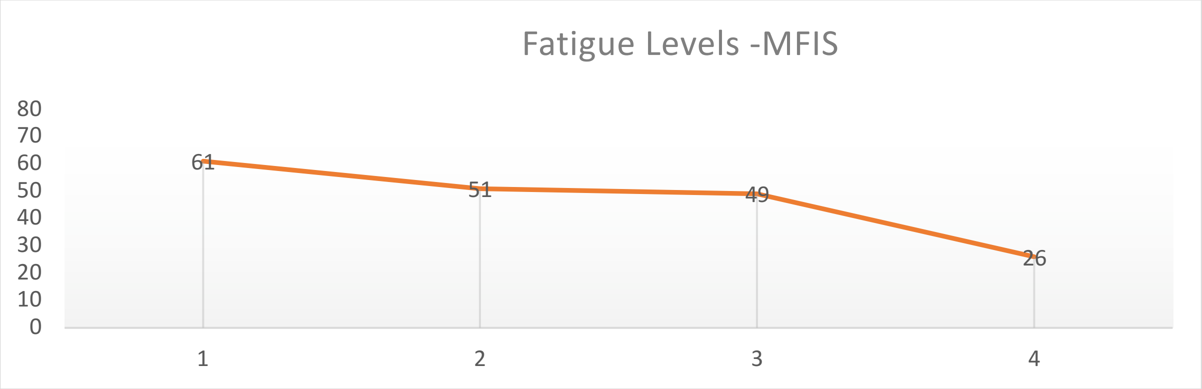
Reliable Change Index

Participant 2's overall fatigue improved significantly post intervention with significant improvements in his cognitive, physical, and psychosocial fatigue (as evidenced in his MFIS scores). His energy and fatigue levels improved significantly after the B1 phase of the intervention (as evidenced in his VAS-F scores). See Figures 2.6, 2.7, and 2.8.

Participant 2 showed significant improvements in depression post treatment. Although his anxiety levels increased significantly after the B1 phase of the intervention session (as evidenced in the second baseline assessment), they dropped to baseline levels at the follow-up baseline assessment. In relation to his overall health (scores on SF-36), participant 2 showed significant improvements in his energy/vitality levels, pain management, social and physical functioning pre and post treatment. He reported understanding PBIF to be the most helpful component of the intervention.

Figure 2.6

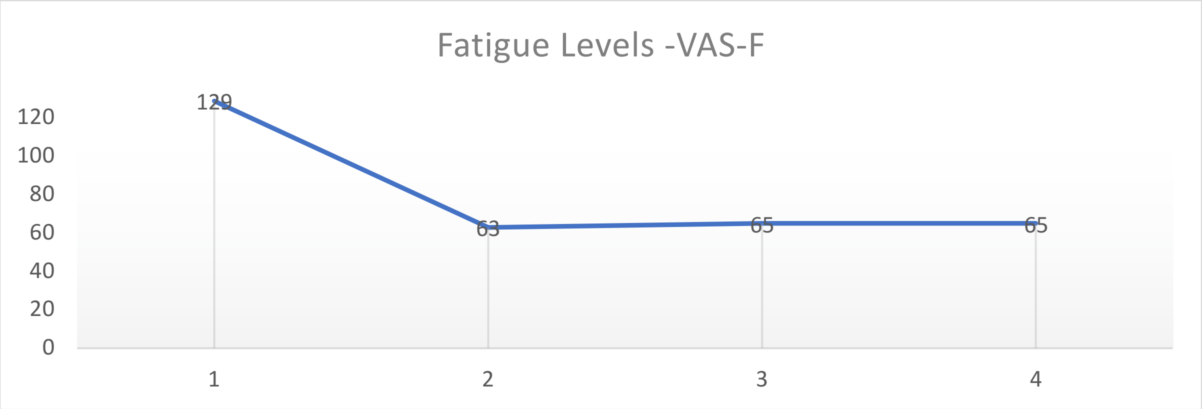
MFIS scores-Participant 2.



Note: Fatigue scores on MFIS over time. Maximum score in the MFIS is 84 and lowest 0. A score of 84 would indicate extreme fatigue, whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicates first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.7

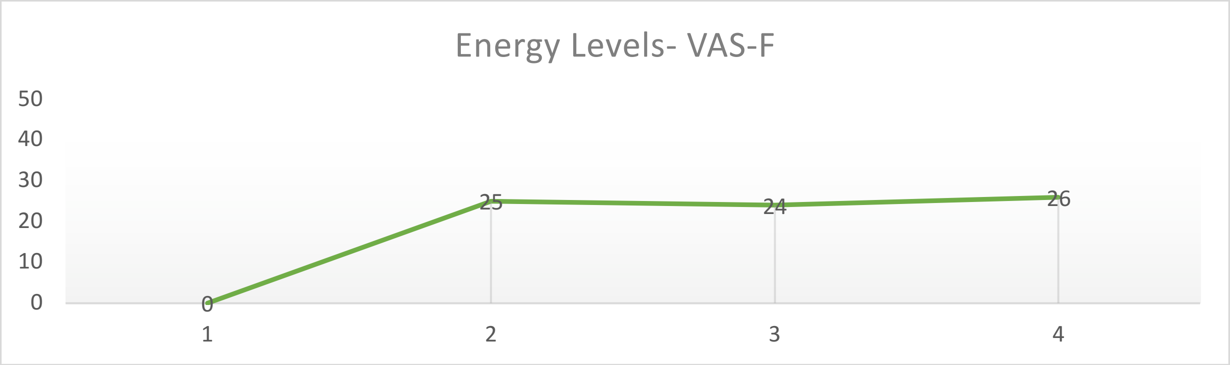
VAS-F Fatigue scores- Participant 2.



Note: Fatigue scores on VAS-F over time. Maximum score is 130 and lowest 0 (questions 1-5, and 11-18 cumulatively). A score of 130 would indicate extreme fatigue whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.8

VAS-F Energy scores- Participant 2.



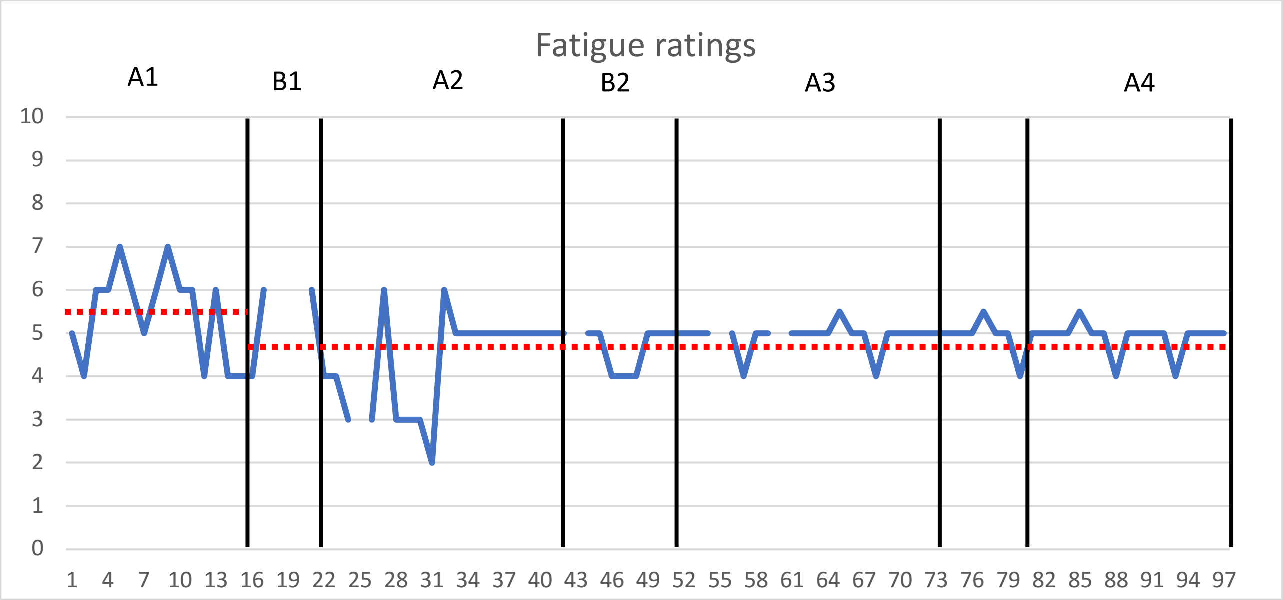
Note: Energy scores on VAS-F over time. Maximum score is 50 and lowest 0 (questions 6-10 of the VAS-F cumulatively). A score of 50 would indicate extreme energy, whereas a score of 0 would indicate no energy. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Visual Analysis

When daily fatigue scores were visually plotted, they remained within the stability window (±25% of the trend line) indicating a zero-*celerating* trend along the ordinate scale (Ledford et al., 2017). See Figure 2.9.

Figure 2.9

Daily fatigue ratings-Participant 2.



Note: Daily fatigue ratings of participant 2 over time. The vertical straight lines indicate the start and end of phase of the intervention. The horizontal lines indicate the average score per phase. Average value of fatigue scores for the baseline=5.40, for the intervention=4.72.

Response to Intervention

Despite the zero-celerating trend, effect size calculations found that there was a significant change between baseline to intervention: Tau = -0.273, $p = 0.005$ ($SE_{\text{Tau}} = 0.143$). The effect size indicated a moderate change suggesting a reduction in fatigue (Tate & Perdices, 2019). Although participant 2 demonstrated a potentially small trend change between baseline and intervention phases, the baseline corrected Tau calculator (http://ktarlow. com/stats/tau; Tarlow, 2016) confirmed this change was significant.

2.7.9 Participant 3

Participant 3 attended her appointments face-to-face at her home. The intervention duration was 3.33 months. Participant 3 did not suffer from anxiety or depression prior to her stroke and her main difficulty was PBIF. Experiencing a stroke had increased her anxiety about her future and relationship and had a negative impact on her mood. She was very well supported by family members and her partner.

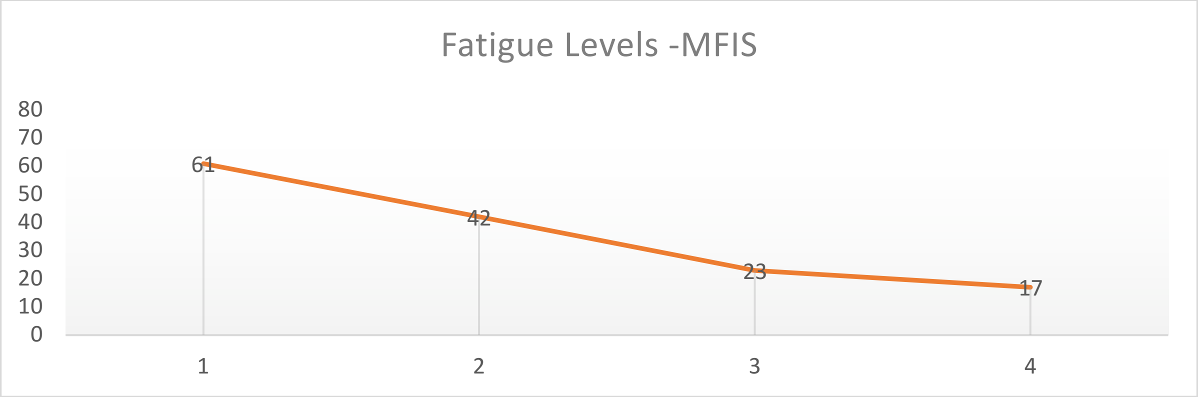
Reliable Change Index

Participant 3's overall fatigue improved significantly after the B1 phase of the intervention (formulation) as evidenced by her MFIS scores. Significant improvements after the B1 phase were also observed in her cognitive, physical, and psychosocial fatigue (MFIS scores). Similarly, her scores in the VAS-F indicated significant improvements in both her energy and fatigue levels after B1. See Figures 2.10, 2.11, and 2.12.

Participant 3 showed significant improvements in depression and anxiety after the B2 phase of the intervention. In relation to her overall health (scores on SF-36), participant 3 showed significant improvements in her physical and social functioning, pain management, mental health, and energy levels pre to post treatment. She reported that making sense of PBIF was extremely helpful in the conceptualisation oh her experience.

Figure 2.10

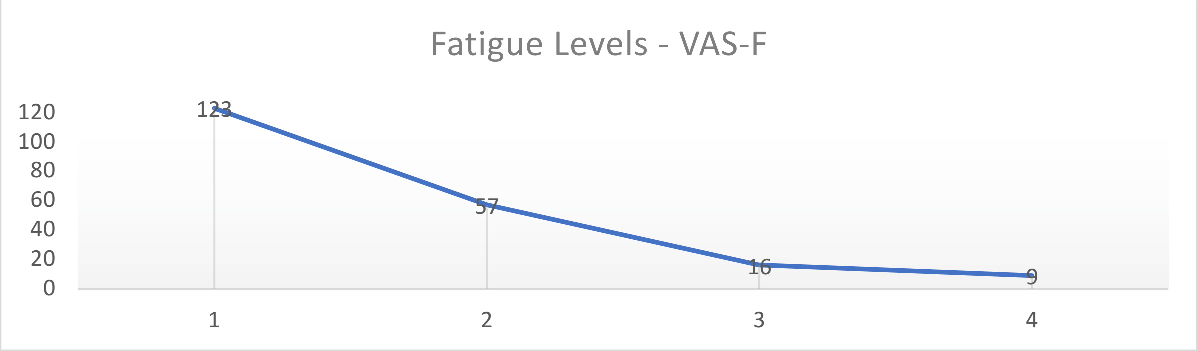
MFIS scores-Participant 3.



Note: Fatigue scores on MFIS over time. Maximum score in the MFIS is 84 and lowest 0. A score of 84 would indicate extreme fatigue, whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicates first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.11

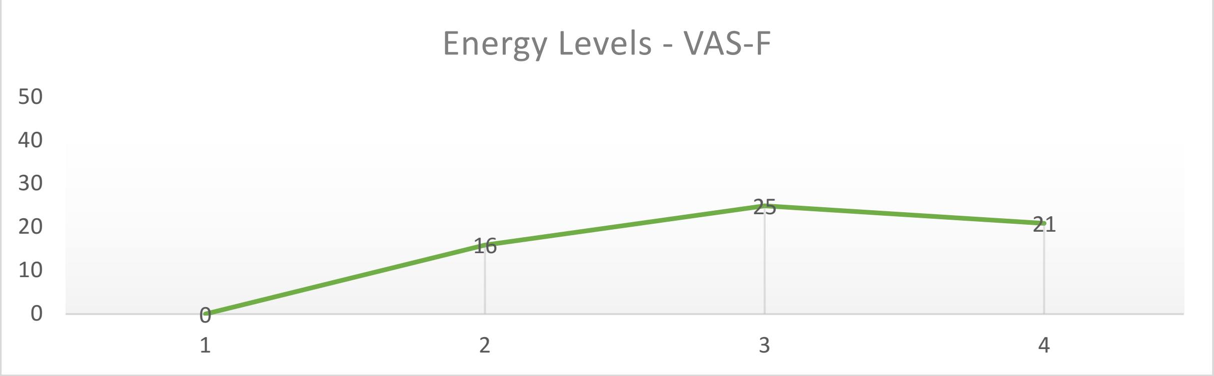
VAS-F Fatigue scores -Participant 3.



Note: Fatigue scores on VAS-F over time. Maximum score is 130 and lowest 0 (questions 1-5, and 11-18 cumulatively). A score of 130 would indicate extreme fatigue whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.12

VAS-F Energy scores -Participant 3.



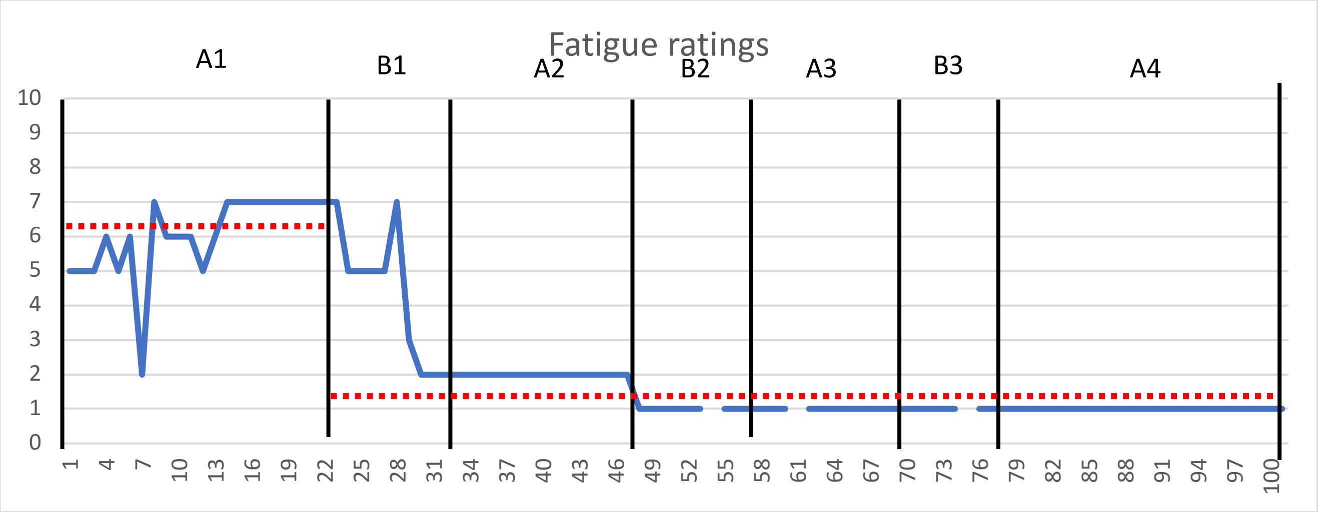
Note: Energy scores on VAS-F over time. Maximum score is 50 and lowest 0 (questions 6-10 of the VAS-F cumulatively). A score of 50 would indicate extreme energy, whereas a score of 0 would indicate no energy. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Visual Analysis

When visually plotting fatigue scores, there was a significant drop between the baseline and intervention (±25% stability window) indicating a *decelerating* (therapeutic) trend along the ordinate scale (Ledford et al., 2017). See Figure 2.13.

Figure 2.13

Daily fatigue ratings -Participant 3.



Note: Daily fatigue ratings of participant 3 over time. The vertical straight lines indicate the start and end of phase of the intervention. The horizontal lines indicate the average score per phase. Average value of fatigue scores for the baseline=6.05, for the intervention=1.60.

Response to Intervention

There was a significant change between baseline and intervention: Tau = -0.674, *p<0.001* (SE_{Tau} = 0.106). The effect size indicates a large change which suggests a reduction in fatigue (Tate & Perdices, 2019).

2.7.10 Participant 4

Participant 4 attended his therapy appointments online. The intervention duration was 3.63 months. Participant 4 was experiencing a lot of anxiety and low mood because of an assault and subsequent traumatic brain injury. He was worrying about his finances, family (father of three children) and was going through a legal battle for his injury. He was experiencing a lot of fatigue symptoms which were affecting his overall functioning. He was struggling to accept the fact that he had sustained a brain injury and was trying to carry on with life as before, prior to his injury. This was inadvertently maintaining his fatigue.

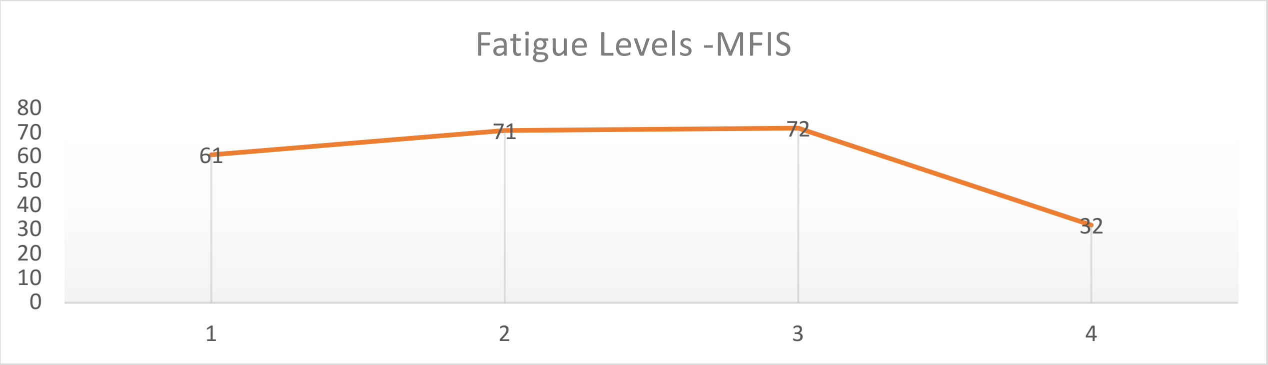
Reliable Change Index

Participant 4's overall fatigue improved significantly after the completion of the intervention and introduction of all therapeutic phases/components as evidenced in his MFIS scores. Similarly, his cognitive, physical, and psychosocial fatigue improved significantly at the same timepoint. His scores in the VAS-F indicated significant improvements in his energy and fatigue after the B1 phase of the intervention (formulation). See Figures 2.14, 2.15 and 2.16.

Participant 4 showed significant improvements in his depression pre-and post-treatment. Although his anxiety levels increased significantly throughout the intervention, they dropped to baseline levels at the end of treatment. In relation to his overall health (SF-36 scores), participant 4 showed significant improvements in his physical and social functioning, pain management and mental health. He reported that accepting the fact that he experiences PBIF and understanding its unique characteristics to be the most helpful component of treatment.

Figure 2.14

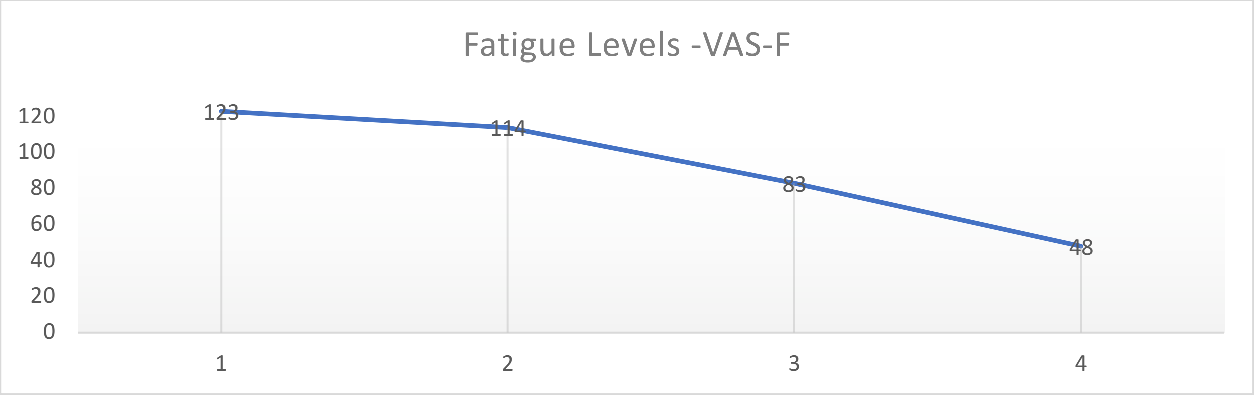
MFIS scores-Participant 4.



Note: Fatigue scores on MFIS over time. Maximum score in the MFIS is 84 and lowest 0. A score of 84 would indicate extreme fatigue, whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicates first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.15

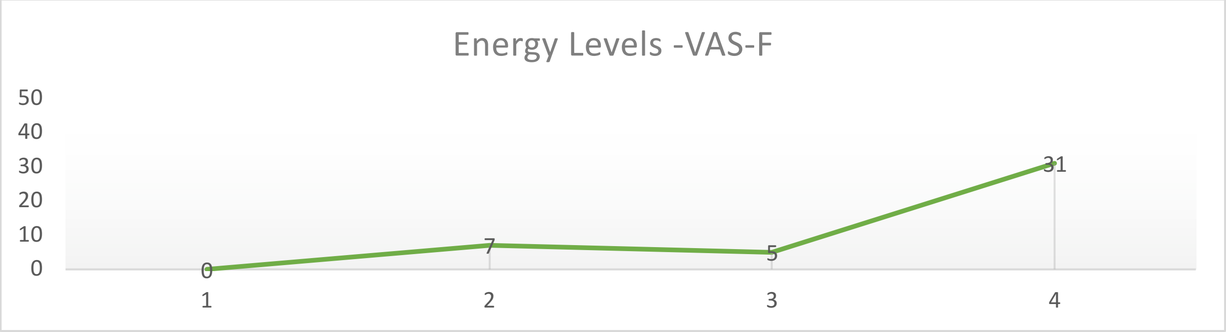
VAS-F Fatigue scores -Participant 4.



Note: Fatigue scores on VAS-F over time. Maximum score is 130 and lowest 0 (questions 1-5, and 11-18 cumulatively). A score of 130 would indicate extreme fatigue whereas a score of 0 would indicate no fatigue. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Figure 2.16

VAS-F Energy scores -Participant 4.



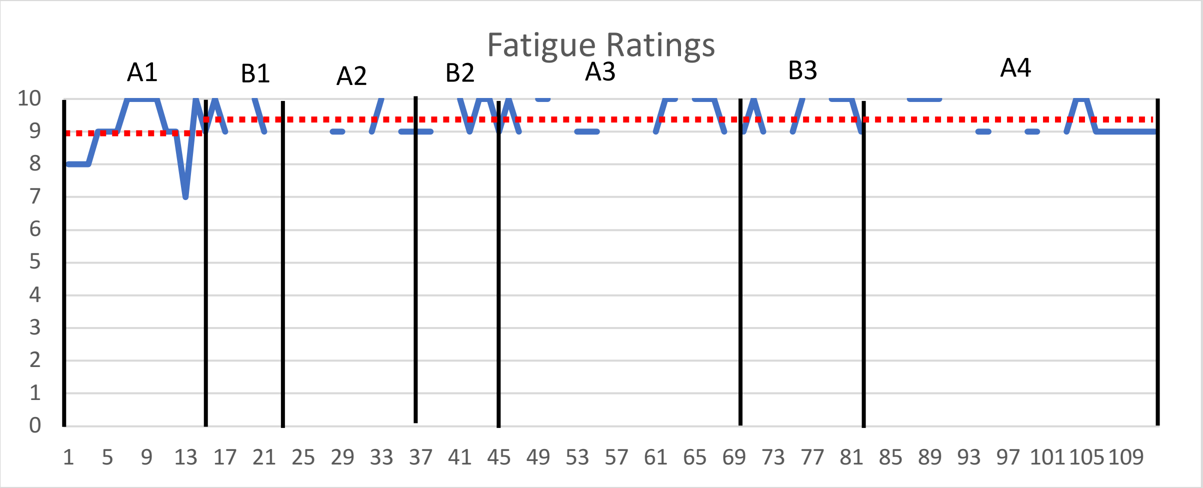
Note: Energy scores on VAS-F over time. Maximum score is 50 and lowest 0 (questions 6-10 of the VAS-F cumulatively). A score of 50 would indicate extreme energy, whereas a score of 0 would indicate no energy. Numbers 1, 2, 3, and 4 indicate first baseline, second baseline, third baseline and follow-up baseline respectively.

Visual Analysis

When plotting fatigue scores visually, they remained within the stability window (±25% of the trend line) indicating a zero-*celerating* trend along the ordinate scale (Ledford et al., 2017). See Figure 2.17.

Figure 2.17

Daily fatigue ratings - Participant 4.



Note: Daily fatigue ratings of participant 2 over time. The vertical straight lines indicate the start and end of phase of the intervention. The horizontal lines indicate the average score per phase. Average value of fatigue scores for the baseline=9, for the intervention=9.40.

Response to Intervention

There was no significant decrease in fatigue ratings between baseline and intervention,

Tau = 0.153, $p = 0.066$ ($SE_{\text{Tau}} = 0.117$).

2.8 Discussion

The aim of this study was to determine the effectiveness of an adapted CBT intervention for ABI survivors experiencing PBIF using a SCED. Furthermore, the study aimed to examine which component of the CBT intervention was the most effective in the management of PBIF.

The results of the study suggest some promising initial findings in terms of the effectiveness of a CBT intervention for the management of PBIF. Our findings suggest that the CBT intervention was well accepted by all participants and that it seems to be effective in reducing their fatigue symptoms as evidenced in some of the participants' outcome measures. All participants appeared to experience significantly less fatigue and higher energy levels post-treatment, as evidenced in their MFIS and VAS-F outcome measures. In addition, most of the participants experienced improvements in their overall health perception and depressive symptoms as evidenced in the GAD-7, PHQ-9 and SF36 questionnaires. These findings are consistent with a previous study evaluating the effectiveness of CBT therapy in ABI survivors experiencing PBIF (Nguyen et al., 2017). Findings are also in line with Raina et al (2016) who found that an online CBT informed intervention can reduce the impact, experience, and severity of PBIF.

All participants reported less fatigue symptoms after the formulation and psychoeducation session was introduced, as evidenced in the VAS-F outcome measure. These findings suggest that the formulation and psychoeducation session was the most effective part of the intervention. It could be argued that formulation enabled participants to better understand their PBIF and in addition to psychoeducation, this session significantly improved their fatigue complaints. It appeared that participants' opportunity to make more sense of the complex concept of PBIF and participate in a joint effort to address their difficulties was enough to demonstrate reliable change in participants' fatigue complaints. This is in line with previous findings suggesting psychoeducation to be the most effective treatment typically offered to ABI patients (Caplain et al., 2019).

These findings seem to highlight the invaluable therapeutic importance of formulation and psychoeducation in psychological therapy (Redhead et al., 2015). Findings suggest that this distinct CBT-component on its own could be enough to contribute to the effectiveness of the CBT intervention. It should be noted that participants fatigue levels did not increase again and that their energy levels remained consistently high throughout the intervention (as evidenced in their VAS-F questionnaires). It could be argued that the formulation and psychoeducation session has been the most effective component of the entire CBT "package".

The same findings, however, were not evident in participants' MFIS questionnaires. Only one out of the four participants (participant 3) reported significantly less fatigue symptoms after the introduction of the formulation/psychoeducation session. Moreover, results on the MFIS outcome measures showed that participants benefited from the entire CBT intervention. These findings suggest that formulation/psychoeducation in isolation may not be enough to produce significant results for all participants. However, the combination of understanding PBIF in addition to learning behavioural and cognitive techniques could be more effective in reducing fatigue symptoms.

Our findings suggest that therapeutic interventions for PBIF can be brief and effective. All participants reported significantly less PBIF symptoms after a brief intervention comprised of six sessions including behavioural and cognitive components (as evidenced in their MFIS and VAS-F questionnaires). Relaxation and mindfulness techniques and pacing strategies may have offered participants the necessary behavioural tools to manage their energy resources more effectively. The cognitive component of the intervention may have allowed participants to identify negative thinking styles and their contribution to the maintenance of PBIF. The summary session was intended to offer space for reflections and may have contributed to consolidating participants' knowledge. As PBIF is a multifaceted experience, addressing its perpetuating factors in treatment in conjunction with educating patients on PBIF can lead to improved outcomes. This is consistent with findings reported by Ymer et al. (2021).

Although all participants showed significant improvement in their overall experience of PBIF compared to their baseline assessments, the findings of the present study showed that daily fatigue ratings did not always match this. Only participant 2 and 3 showed significant improvements post treatment as evidenced in the relevant visual analysis's figures. Wylie and Flashman (2017) argue that the experience of PBIF is unique to every ABI survivor. Pre-morbid fatigue, mental health issues, medical conditions as well as ongoing social factors can also prolong and maintain the experience of PBIF (Mollayeva et al., 2014).

In line with this, participant 1 had been struggling with depression prior to her stroke and had a lot of ongoing social factors that exacerbated her PBIF. Similarly, participant 4 was struggling to cope with the fact that he had sustained an ABI, was in denial of the consequences of PBIF for most of the intervention and was going through a legal battle for his injury. It could be argued that these two participants' daily experience of PBIF was maintained by factors which were not directly addressed by the intervention. However, it is interesting to note that objective changes were still found using psychometric measures. It could be argued that validated outcome measures such as the MFIS and VAS-F as opposed to subjective fatigue ratings based on one question, could be more appropriate to measure the complex phenomenon of PBIF. Future research should aim to further investigate this.

Our findings suggest that a CBT intervention which primarily targets PBIF could be particularly effective. This might explain why a systematic review found CBT's efficacy for the management of PBIF to be poor (Ali et al. 2021). Out of the nine studies included in their review, seven studies did not primarily target participants' PBIF. For example, Potter et al. (2016) aimed to ameliorate broad aspects of post-concussion symptoms and fatigue, which was only assessed as part of six secondary outcome measures. Similarly, although D'Antonio et al. (2013) modified a CBT protocol to address cognitive deficits associated with TBI including fatigue, researchers main target was ABI survivors' depression. It is worth noting that the only two studies included in the review that found CBT for PBIF to be effective, were Nguyen et al. (2017) and Raina et al. (2016). Similar to the present study, researchers' primary target was PBIF suggesting that it is tailored CBT for PBIF which is most likely to be effective.

Our findings suggest that a PBIF intervention could be effective irrespective of the mode of delivery. This is consistent with results reported by Raina et al (2021). Although most of the study's participants attended the intervention face-to-face, our online participant also showed significantly less fatigue symptoms post-treatment (as evidenced in their MFIS and VAS-F outcome measures pre and post treatment). It is interesting to note, however, that our online participant's daily fatigue ratings did not match his outcomes at baseline assessments and remained consistently high throughout the intervention. Future research should involve more online participants to further investigate whether the mode of delivery could account for these differences.

To date, there continues to be a lack of precision in fatigue measurement, evidenced in the variable outcome measures to measure PBIF reported in intervention studies (Manoli et al., 2020). Moreover, it has been argued that momentary assessments and retrospective measures can often reflect different types of information (Lenaert et al., 2020). We found that multidimensional fatigue questionnaires with high internal consistency and reliability can capture significant changes in participants' PBIF symptoms. This is in line with Nguyen et al. (2017) who used the Brief Fatigue Inventory and the Fatigue Severity Scale (FSS) and Raina et al (2016) who used the FSS and the MFIS. Furthermore, use of daily momentary fatigue ratings may be less helpful as not all participants reported a significant change using this method. It could that that a single unidimensional question about fatigue levels does not always capture all dimensions of PBIF.

There were many advantages of acting as both the researcher and clinician in this study. Yanos and Ziedonis (2006) argue that patient-oriented clinician-researchers can serve as effective "bridgers" between academic research and clinical practice and that clinician-researchers can facilitate both the development of research with direct clinical implications and disseminate evidence-based treatments more effectively into routine clinical and services. Acting as both the researcher and clinician whilst being supervised by three experienced health care professionals, the Chief Investigator further developed their clinical and academic skills. Care needed to be taken, however, to address the potential for ethical and role conflicts by routinely reviewing the NHS ethics documents and discussing this in supervision.

The findings of this study, however, should be interpreted with caution given the dual role of the Chief Investigator in both delivering and evaluating the intervention and it is important to reflect on the demand characteristics of this dual role. The Chief Investigator had to spend additional time with participants outside clinical appointments to clarify his dual role after they were recruited and before they consented to participate in the study. There were occasions when participants required additional time to enquire about the research aspect of the study and this may have enhanced the relationship between the clinician-researcher and participants. Furthermore, there were occasions when the research component of the clinician-researcher's duties was impacted. For example, when participants cancelled appointments due to experiencing fatigue, the Chief Investigator had to offer new clinical appointments resulting in changing the original timeline of the intervention.

It is also important to consider the potential for 'apprehension bias' in completing the questionnaires of the study. Clinician-researchers may, knowingly or unknowingly, encourage patient-participants to complete an outcome measure in various ways through physical gestures, vocal intonation, or putting verbal emphasis on certain questions. (Shearer et al., 2021). Although the participants of this study completed the outcome measures independently, the Chief Investigator was physically present in the room with them and available for questions. Helping or guiding participants in completing the questionnaires may have influenced behavioural changes in them and may have led to results different than expected for a specific participant.

In addition to apprehension bias, it is also important to consider the potential for 'response bias'. Participants may have performed or provided responses in a way which they believed was in alignment with the clinician-researcher's expectations or area of interest. It could be that participants wanted to please or not disappoint their clinician and may have been inclined to adjust their answers on questionnaires to be in-line with what they might have thought the clinician-researcher wanted to see. Future research should address these issues with the use of blinding (e.g. having an independent researcher collect outcome measures). Although not always feasible or practical in clinical settings, blinding can help reduce the risk of research bias.

2.8.1 Implications

The study findings suggest formulation/psychoeducation to be the most effective therapeutic component of the entire intervention. In addition, all participants reported qualitatively that understanding PBIF was the most helpful element of the intervention. It could be argued that even brief interventions focusing on formulation/psychoeducation may be enough to facilitate significant change especially when patients' main complaint is PBIF.

Furthermore, the behavioural and cognitive components of the intervention equipped participants with additional strategies contributing to the study's effectiveness as evidenced in participants' MFIS and VAS-F questionnaires. This may highlight the importance of including such techniques in future intervention programmes to further support ABI survivors in the management of PBIF. Our intervention was effective whether offered online or face to face indicating that ABI neurorehabilitation services can offer PBIF interventions in either modality.

An advanced knowledge of CBT and neuropsychology can support clinicians in the delivery of effective therapeutic interventions for PBIF. Regular supervision sessions with a CBT expert can enhance adherence to the CBT protocol and ensure treatment fidelity. Close supervision by a clinical neuropsychologist can support with understanding complex neuropsychological processes and adaptations to therapy.

One of the most important uses of outcome measures in clinical practice is when therapists receive feedback regarding the progress that has been obtained since the beginning of therapy (Hatfield & Ogles, 2004). Obtaining four ratings of participants' fatigue levels throughout the intervention and sharing this with them using relevant graphs facilitated commitment to therapy. Moreover, participants were able to witness the progress they made over time. This enhanced commitment to practising homework tasks and validated their subjective experience of feeling less fatigued. Participants often rescheduled their appointments due to experiencing PBIF. A more flexible approach around the schedule of therapy appointments can facilitate commitment to therapy and encourage patients to engage with treatment.

A CBT expert rated a randomly selected number of session audio recordings and ratings indicated high treatment fidelity. We would encourage future CBT interventions for PBIF to also include fidelity checks to ensure adherence to treatment protocols as this may help explain contradictory findings. To minimise the potential for apprehension and response bias future interventions should use blinding in measurement taking. This could be achieved by involving research assistants who do not have a clinical relationship with participants in the study and are blind to its purpose. In addition, a priori protocols regarding outcome measures' completion should be established to reduce the likelihood for apprehension and response bias.

2.8.2 Strengths of the study

A strength of this study was the treatment fidelity checks. Obtaining high ratings in therapy sessions on all occasions ensured that participants received high-quality/model consistent CBT. Therapeutic alliance constitutes a major variable in explaining the outcome of treatment (Elvins & Green, 2008). All participants scored the maximum possible points in all WAI-SR questionnaires across timepoints (Münder et al., 2009) indicating excellent therapeutic alliance (see Appendix B, Table 4). Participants agreed on the tasks of therapy, agreed with the goals of therapy, and had developed effective rapport with the Chief Investigator. The study also used three methods to measure participants' experience of PBIF enabling researchers to thoroughly explore participants' trajectory of PBIF throughout the intervention.

All participants had sustained their brain injury more than 6 months prior to engaging with the intervention. Recovery at the first stages of ABI can be due to resolution of temporary abnormalities such as oedema or vascular disruption, or due to the depression of metabolic enzyme activity (Wilson & Betteridge, 2019). It is also known that the brain is capable of self-repair after an ABI, especially when secondary damage to the brain is avoided through expert medical care (Fasotti, 2017). None of the participants were at the initial phases of their recovery and most of them had already established behavioural adaptation mechanisms since their injury. This suggests that participants' engagement with the CBT intervention further enhanced their rehabilitation compared to spontaneous recovery.

2.8.3 Limitations

The findings of this study should be interpreted with caution given the limitations of the study design. Although rigorous SCED studies can provide important information on a treatment's efficacy, the generalisability of these results can be somewhat limited as we recruited a small number of participants (Ouellet & Morin, 2007). Future studies should involve larger groups of participants to further investigate the efficacy of this study's protocol in a brain injured population experiencing PBIF.

Our research design lacked a control group which is the case in randomised controlled trials (RTCs). All our participants received the same treatment and were not blinded, so treatment expectations might have influenced outcomes. In RCTs, participants are different from one another in ways which could potentially influence the results of a study, and yet cannot be directly controlled. Random allocation of participants in the control and experimental groups can enable for these influences to be statistically controlled. Moreover, the random allocation of participants to different types of treatments in a RCT can also reduce selection and allocation biases, whilst keeping participants blind to their treatment allocation can reduce more forms of biases, such as experimenter and subject biases (Chalmers et al., 1981). This was not possible in the present study. However, since this SCED study identified an intervention which could potentially be efficacious for the management of post-brain injury fatigue, these preliminary findings could lead to an RCT to further test its efficacy and accelerate the process of treatment development (Cawthorne et al., 2023).

Although we used the PHQ-9, GAD-7 and SF36 to assess for depression, anxiety, and overall health complaints respectively, we did not measure for other comorbid factors which could have resulted in greater fatigue for participants. Pain and irregular distribution of sleeping patterns, for example, are very common in brain injured individuals and this can exacerbate their fatigue symptoms (Zgaljardic et al., 2014). Furthermore, fatigue in brain injury can also be associated with slowed information processing and the need for increased effort in the performance of tasks (Ponsford et al., 2012). Asking participants to practice behavioural and cognitive homework tasks may have resulted in more fatigue as evidenced in some of the participants' daily fatigue ratings. Future studies should address these issues by considering more factors related to fatigue as part of their screening measures.

The methodology of this study used a relatively large battery of psychometric measures to assess for fatigue and other clinical difficulties. This might have further impacted on participants' fatigue levels. Although previous SCED studies testing the same clinical population used a similar number of psychometric tests (Rauwenhoff et al., 2022), it could be argued that asking brain injured patients experiencing fatigue to complete many outcome measures at four baseline assessments, in addition to providing daily fatigue ratings, resulted in more fatigue. Most of the baseline assessments for this study took place as part of a clinical appointment (excluding the online participant). This may have prolonged the duration of that clinical appointment and further contributed to participants' fatigue (although participants were fully aware of this in advance). Future studies should separate psychometric testing from the clinical appointments to minimise the potential for more fatigue.

It is also important to consider the potential for response fatigue especially after having asked fatigued individuals to complete many outcome measures. Questionnaires were given to participants one at a time and were completed in the same order at every baseline assessment (beginning with the fatigue questionnaires and ending with the PHQ-9 and GAD-7 and WAI-SR). It could be that response fatigue impacted on the outcome measures given to participants last. Response fatigue can cause measurement errors and misclassification problems in survey research (Egleston et al., 2011). As the answers given to a set of questionnaires can be a function of both the true responses and participants' response fatigue, it could be that participants were more tired when completing the

PHQ-9, GAD-7, and WAI-SR and participants' responses may not always represent their true experience. Future studies should address this by altering the order of questionnaires.

PBIF is a very complex phenomenon, and its manifestation varies substantially among brain injured patients (Esbjörnsson et al., 2013). The clinician-researcher had developed a good relationship with participants of the study, and frequently prompted them to reflect on their fatigue levels throughout the intervention. Considering, however, the large degree of psychometric testing used, more practical strategies could have been employed at baseline assessments to capture the potential impact of this on participants' fatigue levels and ensure the clinician-researcher was aware of this. For example, a common metaphor used in clinical practice to help clients visualise their energy levels is the spoon theory (Raposo, 2024). Asking participants to resemble every outcome measure with a number of spoons could have enabled a better insight into how tiring the process might have been for them.

Previous research has found that involving family members can shift the focus of rehabilitation to a more family-centric recovery, that is more relevant and of value to the individual (Wilson et al., 2017). Moreover, the Kneebone CBT for stroke protocol specifically mentions family involvement as an adaptation to CBT when severity of injury is greater (Kneebone, 2016). Our study excluded participates with severe injuries and did not involve family members. This could be addressed by future research by involving carers or family members and recruiting participants with more severe brain injuries.

Our study recruited three stroke survivors and a participant who suffered a TBI. Future research should explore the benefits of CBT interventions for PBIF in a more varied clinical population to establish its effectiveness in more than one group of brain injury survivors, such as for hypoxic brain injury.

Participants' fatigue levels were measured at four different timepoints throughout the intervention; at baseline, at the end of the second and third withdrawal phase and at the follow-up. Researchers were able to measure the impact of the first (assessment and formulation/psychoeducation) and second therapeutic component (behavioural component) of the intervention but did not measure the impact of the third therapeutic component (cognitive element). Future research should address this to further dismantle a CBT intervention. Moreover, it could be useful to randomise the order of intervention phases across participants to determine whether the order of delivery can be of significance.

Participants' daily fatigue ratings did not demonstrate improvements on all occasions. Researchers have shown that human choices are highly sensitive to the ways in which alternatives are presented (Gosling & Moutier, 2018). In our study, participants were asked to rate their fatigue levels. It could be that an alternative question focusing on rating energy levels instead, could provide a more positive framework and lead to alternative outcomes. Future studies should examine this.

Cultural factors have been found to influence behaviour in patients recovering from acquired brain injury (Lequerica & Krch, 2014). Three participants of this study identified as white British and one as white South African. Future research should trial the CBT intervention involving participants from different cultural backgrounds to test its efficacy across cultures.

2.9 Conclusions

In conclusion, findings of this study suggest that an adapted CBT intervention was effective in reducing PBIF in four ABI patients using SCED. Some of the study's findings showed that formulation and psychoeducation was the most effective treatment component of the entire intervention. In addition, other findings suggest that equipping participants with relaxation, pacing and cognitive restructuring techniques contributed to the effectiveness of the study and enabled participants to successfully manage their fatigue symptoms. However, although significant differences were observed in participants' fatigue levels in comparison to their baseline assessments, this was not always evident in their daily fatigue ratings. Only two participants' daily fatigue ratings were statistically less significant post-treatment compared to baseline.

The findings of this study should be interpreted with caution given the limitations of the design of the study. Although preliminary findings suggest important implications for clinical practice, further research including a control group is necessary to further examine the protocol of this study. Future research should also replicate the experiment using a larger number of participants, a more diverse ABI population, and a longer follow-up.

2.10 Acknowledgments

This study was funded by University of Southampton. We declare no conflicts of interest.

2.11 References

Ablewhite, J., Nouri, F., Whisker, A., Thomas, S., Jones, F., Nair, R. D., Condon, L., Jones, A., Sprigg, N., & Drummond, A. (2022). How do stroke survivors and their caregivers manage post-stroke fatigue? A qualitative study. *Clinical Rehabilitation*, *36*(10), 1400–1410. https://doi.org/10.1177/02692155221107738

Åkerlund, E., Sunnerhagen, K. S., & Persson, H. (2021). Fatigue after acquired brain injury impacts health-related quality of life: an exploratory cohort study. *Scientific Reports*, *11*(1). https://doi.org/10.1038/s41598-021-01617-4

Aimaretti, G., Ambrosio, M. R., Benvenga, S., Borretta, G., De Marinis, L., De Menis, E., Di Somma, C., Faustini-Fustini, M., Grottoli, S., Gasco, V., Gasperi, M., Logoluso, F., Scaroni, C., Giordano, G., & Ghigo, E. (2004). Hypopituitarism and growth hormone deficiency (GHD) after traumatic brain injury (TBI). *Growth Hormone & IGF Research*, *14*, 114–117. https://doi.org/10.1016/j.ghir.2004.03.025

Alderwick, H. (2022). Is the NHS overwhelmed? *The BMJ*, o51. https://doi.org/10.1136/bmj.o51

Ali, A., Morfin, J., Mills, J., Pasipanodya, E., Maas, Y. J., Huang, E., Dirlikov, B., Englander, J., & Zedlitz, A. (2021b). Fatigue after Traumatic Brain Injury: A Systematic review. *The Journal of Head Trauma Rehabilitation*, *37*(4), E249–E257. https://doi.org/10.1097/htr.0000000000000710

Ali, A., Morfin, J., Mills, J., Pasipanodya, E., Maas, Y. J., Huang, E., Dirlikov, B., Englander, J., & Zedlitz, A. (2021). Fatigue after Traumatic Brain Injury: A Systematic review. *The Journal of Head Trauma Rehabilitation*, *37*(4), E249–E257. https://doi.org/10.1097/htr.0000000000000710

Belmont, A., Agar, N. Y., Hugeron, C., Gallais, B., & Azouvi, P. (2006). Fatigue and traumatic brain injury. *Annales De Réadaptation Et De Médecine Physique*, *49*(6), 370–374. https://doi.org/10.1016/j.annrmp.2006.04.018

Bischoff, T., Anderson, S. R., Heafner, J., & Tambling, R. B. (2020). Establishment of a reliable change index for the GAD-7. *Psychology, Community & Health (Em Linha)*, *8*(1), 176–187. https://doi.org/10.5964/pch.v8i1.309

Blackburn, I.-M. *et al.* (2001) 'The revised Cognitive therapy scale (CTS-R): Psychometric properties', *Behavioural and Cognitive Psychotherapy*, 29(4), pp. 431–446. doi:10.1017/s1352465801004040

Brazier, J., Harper, R., Jones, N., O'Cathain, A., Thomas, K., Usherwood, T., & Westlake, L. (1992). Validating the SF-36 health survey questionnaire: new outcome measure for primary care. *The BMJ*, *305*(6846), 160–164. https://doi.org/10.1136/bmj.305.6846.160

Brett, C., Sykes, C., & Pires-Yfantouda, R. (2015). Interventions to increase engagement with rehabilitation in adults with acquired brain injury: A systematic review. *Neuropsychological Rehabilitation*, *27*(6), 959–982. https://doi.org/10.1080/09602011.2015.1090459

Burholt, V. and Nash, P. (2011) 'Short form 36 (SF-36) Health Survey Questionnaire: Normative Data for Wales', *Journal of Public Health*, 33(4), pp. 587–603. doi:10.1093/pubmed/fdr006

Cantor, J., Ashman, T., Gordon, W. A., Ginsberg, A., Engmann, C., Egan, M., Spielman, L., Dijkers, M. P., & Flanagan, S. R. (2008). Fatigue after traumatic brain injury and its impact on participation and quality of life. *The Journal of Head Trauma Rehabilitation*, *23*(1), 41–51. https://doi.org/10.1097/01.htr.0000308720.70288.af

Cantor, J., Gordon, W. A., & Gumber, S. (2013). What is post TBI fatigue? *NeuroRehabilitation*, *32*(4), 875–883. https://doi.org/10.3233/nre-130912

Cantor, J., Ashman, T., Bushnik, T., Cai, X., Farrell-Carnahan, L., Gumber, S., Hart, T., Rosenthal, J., & Dijkers, M. (2014). Systematic Review of Interventions for fatigue after Traumatic Brain Injury. *The Journal of Head Trauma Rehabilitation*, *29*(6), 490–497. https://doi.org/10.1097/htr.0000000000000102

Caplain, S., Chenuc, G., Blancho, S., Marque, S., & Aghakhani, N. (2019). Efficacy of Psychoeducation and Cognitive Rehabilitation After Mild Traumatic Brain Injury for Preventing Post-concussional Syndrome in Individuals With High Risk of Poor Prognosis: A Randomized Clinical Trial. *Frontiers In Neurology*, *10*.

Cawthorne, T., Käll, A., Bennett, S., Baker, E., Cheung, E., & Shafran, R. (2023). Do single-case experimental designs lead to randomised controlled trials of cognitive behavioural therapy interventions for adolescent anxiety and related disorders recommended in the National Institute of Clinical Excellence guidelines? A systematic review. *JCPP Advances*, *3*(3). https://doi.org/10.1002/jcv2.12181

Chalmers, T. C., Smith, H., Blackburn, B., Silverman, B., Schroeder, B., Reitman, D., & Ambroz, A. (1981). A method for assessing the quality of a randomized control trial. *Controlled Clinical Trials*, *2*(1), 31–49. https://doi.org/10.1016/0197-2456(81)90056-8

Chaudhuri, A., & Behan, P. O. (2000). Fatigue and basal ganglia. *Journal of the Neurological Sciences*, *179*(1–2), 34–42. https://doi.org/10.1016/s0022-510x(00)00411-1

Chaudhuri, A., & Behan, P. O. (2004). Fatigue in neurological disorders. *The Lancet*, *363*(9413), 978–988. https://doi.org/10.1016/s0140-6736(04)15794-2

Coyle, E.F., J.M. Hagberg, B.F. Hurley, W.H. Martin, A.A. Ehsani, and J.O. Holloszy (1993). Carbohydrate feeding during prolonged strenuous exercise can delay fatigue. *J. Appl. Physiol.* 55: 230-235.

Cuijpers, P., Donker, T., Van Straten, A., Li, J., & Andersson, G. (2010). Is guided self-help as effective as face-to-face psychotherapy for depression and anxiety disorders? A systematic review and meta-analysis of comparative outcome studies. *Psychological Medicine*, *40*(12), 1943–1957. https://doi.org/10.1017/s0033291710000772

D'Antonio, E., Tsaousides, T., Spielman, L., & Gordon, W. A. (2013). Depression and traumatic brain injury: symptom profiles of patients treated with cognitive–behavioural therapy or supportive psychotherapy. *Neuropsychiatry*, *3*(6), 601–609. https://doi.org/10.2217/npy.13.75

Dean, P., Sato, J. R., Vieira, G., McNamara, A., & Sterr, A. (2014). Multimodal imaging of mild traumatic brain injury and persistent postconcussion syndrome. *Brain and Behaviour*, *5*(1). https://doi.org/10.1002/brb3.292

De Doncker, W., Dantzer, R., Ormstad, H., & Kuppuswamy, A. (2017). Mechanisms of poststroke fatigue. *Journal of Neurology, Neurosurgery and Psychiatry*, *89*(3), 287–293. https://doi.org/10.1136/jnnp-2017-316007

DeLuca, J., 2005. Fatigue: Its definition, its study, and its future. In J. DeLuca (Ed.). *Fatigue as a window to the brain (*1st ed., pp.219-325). Cambridge, MA: MIT Press.

Dobryakova, E., DeLuca, J., Genova, H. M., & Wylie, G. R. (2013). Neural correlates of cognitive fatigue: Cortico-Striatal circuitry and Effort–Reward imbalance. *Journal of the International Neuropsychological Society*, *19*(8), 849–853. https://doi.org/10.1017/s1355617713000684

Elvins, R., & Green, J. (2008). The conceptualization and measurement of therapeutic alliance: An empirical review. *Clinical Psychology Review*, *28*(7), 1167–1187. https://doi.org/10.1016/j.cpr.2008.04.002

Egleston, B. L., Miller, S. M., & Meropol, N. J. (2011). The impact of misclassification due to survey response fatigue on estimation and identifiability of treatment effects. *Statistics in Medicine*, *30*(30), 3560–3572. https://doi.org/10.1002/sim.4377

Epstein, L. H., & Dallery, J. (2022). The family of Single-Case experimental designs. *Harvard Data Science Review*. https://doi.org/10.1162/99608f92.ff9300a8

Esbjörnsson, E., Skoglund, T., & Sunnerhagen, K. (2013). Fatigue, psychosocial adaptation and quality of life one year after traumatic brain injury and suspected traumatic axonal injury; evaluations of patients and relatives: A pilot study. *Journal of Rehabilitation Medicine*, *45*(8), 771–777. https://doi.org/10.2340/16501977-1170

Fasotti, L. (2017). Mechanisms of recovery after acquired brain injury. In B. A. Wilson, J. Winegardner, C. M. van Heugten, & T. Ownsworth (Eds.), *Neuropsychological rehabilitation: The international handbook* (pp. 25–35). Routledge/Taylor & Francis Group.

Feiger, J. A., Snyder, R. L., Walsh, M. J., Cissne, M., Cwiek, A., Al-Momani, S., & Chiou, K. S. (2022). The role of neuroinflammation in neuropsychiatric disorders following Traumatic Brain Injury: a Systematic review. *The Journal of Head Trauma Rehabilitation*, *37*(5), E370–E382. https://doi.org/10.1097/htr.0000000000000754

Fingerhut, J., Xu, X., & Moeyaert, M. (2021). Selecting the proper Tau-U measure for single-case experimental designs: Development and application of a decision flowchart. *Evidence-based Communication Assessment and Intervention/Evidence Based Communication Assessment and Intervention*, *15*(3), 99–114. https://doi.org/10.1080/17489539.2021.1937851

Gentleman, S., Leclercq, P. D., Moyes, L., Graham, D. I., Smith, C., Griffin, W. S. T., & Nicoll, J. a. R. (2004). Long-term intracerebral inflammatory response after traumatic brain injury. *Forensic Science International*, *146*(2–3), 97–104. https://doi.org/10.1016/j.forsciint.2004.06.027

Gómez-De-Regil, L., Estrella-Castillo, D. F., & Vega-Cauich, J. I. (2019). Psychological intervention in traumatic brain injury patients. *Behavioural Neurology*, *2019*, 1–8. https://doi.org/10.1155/2019/6937832.

Gosling, C. J., & Moutier, S. (2018). Is the framing effect a framing affect? *Quarterly Journal of Experimental Psychology*, *72*(6), 174702181879601. https://doi.org/10.1177/1747021818796016

Graham, J. E., Karmarkar, A. M., & Ottenbacher, K. J. (2012). Small sample Research Designs for Evidence-Based Rehabilitation: Issues and Methods. *Archives of Physical Medicine and Rehabilitation*, *93*(8), S111–S116. https://doi.org/10.1016/j.apmr.2011.12.017

Guy, L., McKinstry, C. and Bruce, C. (2019) 'Effectiveness of pacing as a learned strategy for people with chronic pain: A systematic review', *The American Journal of Occupational Therapy*, 73(3). doi:10.5014/ajot.2019.028555.

Hatfield, D., & Ogles, B. M. (2004). The use of outcome measures by psychologists in clinical practice. *Professional Psychology, Research and Practice*, *35*(5), 485–491. https://doi.org/10.1037/0735-7028.35.5.485

Headway. Acquired Brain Injury 2019–2020: statistics based on UK admissions. 2019. Available from: https://www.headway.org.uk/about-brain-injury/further-information/statistics

Hellawell, R. T. D. J. (1999). Cognitive and psychosocial outcome following moderate or severe traumatic brain injury. *Brain Injury*, *13*(7), 489–504. https://doi.org/10.1080/026990599121403

Hofmann, S., Asnaani, A., Vonk, I. J. J., Sawyer, A. T., & Fang, A. (2012). The Efficacy of Cognitive Behavioural therapy: A review of Meta-analyses. *Cognitive Therapy and Research*, *36*(5), 427–440. https://doi.org/10.1007/s10608-012-9476-1

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, *59*(1), 12–19. https://doi.org/10.1037/0022-006x.59.1.12

Jones, J., Haslam, S. A., Jetten, J., Williams, H., Morris, R., & Saroyan, S. (2011). That which doesn't kill us can make us stronger (and more satisfied with life): The contribution of personal and social changes to well-being after acquired brain injury. *Psychology & Health*, *26*(3), 353–369. https://doi.org/10.1080/08870440903440699

Kneebone, I. (2016). A framework to support cognitive behaviour therapy for emotional disorder after stroke. *Cognitive and Behavioural Practice*, *23*(1), 99–109. https://doi.org/10.1016/j.cbpra.2015.02.001

Krasny-Pacini, A., & Evans, J. J. (2018b). Single-case experimental designs to assess intervention effectiveness in rehabilitation: A practical guide. *Annals of Physical and Rehabilitation Medicine*, *61*(3), 164–179. https://doi.org/10.1016/j.rehab.2017.12.002

Kelly, B., McClement, S., & Chochinov, H. M. (2006). Measurement of psychological distress in palliative care. *Palliative Medicine*, *20*(8), 779-789. https://doi.org/10.1177/0269216306072347

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x.

Kusnanto, H., Agustian, D., & Hilmanto, D. (2018). Biopsychosocial model of illnesses in primary care: A hermeneutic literature review. *Journal of Family Medicine and Primary Care*, *7*(3), 497. https://doi.org/10.4103/jfmpc.jfmpc_145_17

Larson, R. D. (2013). Psychometric properties of the modified Fatigue Impact scale. *International Journal of MS Care*, *15*(1), 15–20. https://doi.org/10.7224/1537-2073.2012-019

Leavitt, V. M., & DeLuca, J. (2010b). Central fatigue: issues related to cognition, mood and behaviour, and psychiatric diagnoses. *PM & R*, *2*(5), 332–337. https://doi.org/10.1016/j.pmrj.2010.03.027

Ledford, J. R., & Gast, D. L. (2014). *Single case Research Methodology: Applications in Special Education and Behavioural Sciences*. Routledge.

Ledford, J. R., Lane, J. D., & Severini, K. E. (2017). Systematic use of visual analysis for assessing outcomes in single case design studies. *Brain Impairment*, *19*(1), 4–17. https://doi.org/10.1017/brimp.2017.16

Lee, K. A., Hicks, G. E., & Niño-Murcia, G. (1991). Validity and reliability of a scale to assess fatigue. *Psychiatry Research*, *36*(3), 291–298.

Lenaert, B., Van Kampen, N., Van Heugten, C., & Ponds, R. (2020). Real-time measurement of post-stroke fatigue in daily life and its relationship with the retrospective Fatigue Severity

Scale. *Neuropsychological Rehabilitation*, *32*(6), 992–1006. https://doi.org/10.1080/09602011.2020.1854791

Lerdal, A., Bakken, L. N., Kouwenhoven, S. E., Pedersen, G., Kirkevold, M., Finset, A., & Kim, H. S. (2009). Poststroke Fatigue—A review. *Journal of Pain and Symptom Management*, *38*(6), 928–949. https://doi.org/10.1016/j.jpainsymman.2009.04.028

Lequerica, A., & Krch, D. (2014). Issues of cultural diversity in acquired brain injury (ABI) rehabilitation. *NeuroRehabilitation*, *34*(4), 645–653. https://doi.org/10.3233/nre-141079

Levine, J., & Greenwald, B. D. (2009). Fatigue in Parkinson disease, stroke, and traumatic brain injury. *Physical Medicine and Rehabilitation Clinics of North America. 20(2), 347-361.*

Li, M., & Sirko, S. (2018). Traumatic brain injury: At the crossroads of Neuropathology and common metabolic endocrinopathies. *Journal of Clinical Medicine*, *7*(3), 59.

López-López, J. A., Davies, S., Caldwell, D. M., Churchill, R., Peters, T. J., Tallon, D., Dawson, S., Wu, Q., Li, J., Taylor, A., Lewis, G., Keßler, D., Wiles, N., & Welton, N. J. (2019). The process and delivery of CBT for depression in adults: a systematic review and network meta-analysis. *Psychological Medicine*, *49*(12), 1937–1947. https://doi.org/10.1017/s003329171900120x

Lozano, D., Gonzales-Portillo, G. S., Acosta, S., De La Peña, I., Tajiri, N., Kaneko, Y., & Borlongan, C. V. (2015). Neuroinflammatory responses to traumatic brain injury: aetiology, clinical consequences, and therapeutic opportunities. *Neuropsychiatric Disease and Treatment*, 97. https://doi.org/10.2147/ndt.s65815

Manoli, R., Chartaux-Danjou, L., Delecroix, H., Daveluy, W., & Moroni, C. (2020). Is Multidimensional Fatigue Inventory (MFI-20) adequate to measure brain injury related fatigue? *Disability and Health Journal*, *13*(3), 100913. https://doi.org/10.1016/j.dhjo.2020.100913

Masel, B. E., Zgaljardic, D. J., & Forman, J. (2015). Post-traumatic hypopituitarism and fatigue. *Neuropsychological Rehabilitation*, *27*(7), 1071–1079. https://doi.org/10.1080/09602011.2015.1125374

Marasigan, P. (2019). Using brief cognitive restructuring and cognitive defusion techniques to cope with negative thoughts. *Social Values & Society*, *1*(4), 11–14. https://doi.org/10.26480/svs.04.2019.11.14

McAllister, T. W., Saykin, A. J., Flashman, L. A., Sparling, M. B., Johnson, S. C., Guerin, S., Mamourian, A. C., Weaver, J. B., & Yanofsky, N. N. (1999). Brain activation during working memory 1 month after mild traumatic brain injury. *Neurology*, *53*(6), 1300. https://doi.org/10.1212/wnl.53.6.1300

Micklewright, D., St Clair Gibson, A., Gladwell, V., & Salman, A. (2017). Development and validity of the Rating-of-Fatigue Scale. *Sports Medicine*, *47*(11), 2375–2393. https://doi.org/10.1007/s40279-017-0711-5

Mills, R., Young, C. A., Pallant, J., & Tennant, A. (2010). Rasch analysis of the Modified Fatigue Impact Scale (MFIS) in multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry*, *81*(9), 1049–1051. https://doi.org/10.1136/jnnp.2008.151340

Mikolasek, M., Van Der Berg, J., Witt, C. M., & Barth, J. (2017). Effectiveness of Mindfulness- and Relaxation-Based eHealth Interventions for Patients with Medical Conditions: a Systematic Review and Synthesis. *International Journal of Behavioural Medicine*, *25*(1), 1–16. https://doi.org/10.1007/s12529-017-9679-7

Mollayeva, T., Kendzerska, T., Mollayeva, S., Shapiro, C. M., Colantonio, A., & Cassidy, J. D. (2014). A systematic review of fatigue in patients with traumatic brain injury: The course, predictors, and consequences. *Neuroscience & Biobehavioral Reviews*, *47*, 684–716. https://doi.org/10.1016/j.neubiorev.2014.10.024

Münder, T., Wilmers, F., Leonhart, R., Linster, H. W., & Barth, J. (2009). Working Alliance Inventory-Short Revised (WAI-SR): psychometric properties in outpatients and inpatients. *Clinical Psychology & Psychotherapy/Clinical Psychology and Psychotherapy*, *17*(3), 231–239. https://doi.org/10.1002/cpp.658

Nguyen, S., McKay, A., Wong, D., Rajaratnam, S. M., Spitz, G., Williams, G., Mansfield, D., & Ponsford, J. L. (2017). Cognitive behaviour therapy to treat sleep disturbance and fatigue after traumatic brain injury: A pilot randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, *98*(8).

Ponsford, J. L., Ziino, C., Parcell, D. L., Shekleton, J. A., Roper, M., Redman, J. R., Phipps-Nelson, J., & Rajaratnam, S. M. W. (2012). Fatigue and Sleep Disturbance Following Traumatic Brain Injury—Their Nature, Causes, and Potential Treatments. *the Journal of Head Trauma Rehabilitation/Journal of Head Trauma Rehabilitation*, *27*(3), 224–233. https://doi.org/10.1097/htr.0b013e31824ee1a8

Ponsford, J. L., Downing, M., Olver, J., Ponsford, M., Acher, R., Carty, M., & Spitz, G. (2014). Longitudinal Follow-Up of Patients with Traumatic Brain Injury: Outcome at Two, Five, and Ten Years Post-Injury. *Journal of Neurotrauma*, *31*(1), 64–77. https://doi.org/10.1089/neu.2013.2997

Potter, S., Brown, R. G., & Fleminger, S. (2016). Randomised, waiting list-controlled trial of cognitive–behavioural therapy for persistent post concussional symptoms after predominantly mild–moderate traumatic brain injury. *Journal of Neurology, Neurosurgery and Psychiatry*, *87*(10), 1075–1083. https://doi.org/10.1136/jnnp-2015-312838

Ouellet, M., & Morin, C. M. (2007). Efficacy of Cognitive-Behavioural therapy for insomnia Associated with Traumatic Brain Injury: A Single-Case Experimental design. *Archives of Physical Medicine and Rehabilitation*, *88*(12), 1581–1592. https://doi.org/10.1016/j.apmr.2007.09.006

Raina, K. D., Morse, J. Q., Chisholm, D., Whyte, E. M., & Terhorst, L. (2022). An internet-based self-management intervention to reduce fatigue among people with traumatic brain injury: A pilot randomized controlled trial. *The American Journal of Occupational Therapy*, *76*(4).

Raposo, J. (2024, June 7). What is Spoon Theory, and what are the benefits? *GoodRx*. https://www.goodrx.com/health-topic/mental-health/spoon-theory

Rauwenhoff, J., Bol, Y., Peeters, F., Van Den Hout, A. J., Geusgens, C., & Van Heugten, C. (2022). Acceptance and commitment therapy for individuals with depressive and anxiety symptoms following acquired brain injury: A non-concurrent multiple baseline design across four cases. *Neuropsychological Rehabilitation*, *33*(6), 1018–1048. https://doi.org/10.1080/09602011.2022.2053169

Redhead, S., Johnstone, L., & Nightingale, J. (2015). Clients' experiences of formulation in cognitive behaviour therapy. *Psychology and Psychotherapy*, *88*(4), 453–467. https://doi.org/10.1111/papt.12054

Rönnbäck, L., & Johansson, B. (2022). Long-Lasting Pathological Mental Fatigue after Brain Injury–A dysfunction in glutamate neurotransmission? *Frontiers in Behavioural Neuroscience*, *15*. https://doi.org/10.3389/fnbeh.2021.791984

Schiehser, D. M., Delano-Wood, L., Jak, A. J., Hanson, K. L., Sorg, S. F., Orff, H. J., & Clark, A. L. (2016). Predictors of cognitive and physical fatigue in post-acute mild–moderate traumatic brain injury. *Neuropsychological Rehabilitation*, *27*(7), 1031–1046. https://doi.org/10.1080/09602011.2016.1215999

Shahid, A., Wilkinson, K., Marcu, S., & Shapiro, C. M. (2011). Visual Analogue Scale to Evaluate Fatigue Severity (VAS-F). In *Springer eBooks* (pp. 399–402). https://doi.org/10.1007/978-1-4419-9893-4_100

Shearer, A., Guptill, C., McKillop, A., & Gross, D. P. (2021). Ethical and Methodological Considerations for The Clinician-Scientist: a Call for Reflexivity. *Clinical Ethics*, *17*(4), 352–357. https://doi.org/10.1177/14777509211052470

Shumskaya, E., Andriessen, T. M., Norris, D. G., & Vos, P. E. (2012). Abnormal whole-brain functional networks in homogeneous acute mild traumatic brain injury. *Neurology*, *79*(2), 175–182. https://doi.org/10.1212/wnl.0b013e31825f04fb

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine*, *166*(10), 1092. https://doi.org/10.1001/archinte.166.10.1092

Stocker, R., Tran, T., Hammarberg, K., Nguyen, H., Rowe, H., & Fisher, J. (2021). Patient Health Questionnaire 9 (PHQ-9) and General Anxiety Disorder 7 (GAD-7) data contributed by 13,829 respondents to a national survey about COVID-19 restrictions in Australia. *Psychiatry Research*, *298*, 113792. https://doi.org/10.1016/j.psychres.2021.113792

Strober, L. B., Bruce, J. M., Arnett, P. A., Alschuler, K. N., DeLuca, J., Chiaravalloti, N. D., Lebkuecher, A. L., Benedetto, M., Cozart, J. S., Thelen, J., Guty, E., & Román, C. a. F. (2020). Tired of not knowing what that fatigue score means? Normative data of the Modified Fatigue Impact Scale (MFIS). *Multiple Sclerosis and Related Disorders (Print)*, *46*, 102576. https://doi.org/10.1016/j.msard.2020.102576

Stuart, B. K., Mandleco, B., Wilshaw, R., Beckstrand, R. L., & Heaston, S. (2012). Mild Traumatic brain injury: Are ED providers identifying which patients are at risk? *Journal of Emergency Nursing*, *38*(5), 435–442. https://doi.org/10.1016/j.jen.2011.04.006

Tarlow, K. R. (2016). Baseline Corrected Tau Calculator. http://www.ktarlow.com/stats/tau

Tate, R., & Perdices, M. (2019). *Single-Case experimental designs for clinical research and neurorehabilitation settings: Planning, Conduct, Analysis and Reporting*. Routledge.

Tomar, S., Sharma, A., Jain, A., Sinha, V. D., & Gupta, I. D. (2018). Study of fatigue and associated factors in traumatic brain injury and its correlation with insomnia and depression. *Asian Journal of Neurosurgery*, *13*(04), 1061–1065. https://doi.org/10.4103/ajns.ajns_89_17

Tornero-Aguilera, J. F., Jimenez-Morcillo, J., Rubio-Zarapuz, A., & Clemente-Suárez, V. J. (2022). Central and peripheral fatigue in physical exercise explained: A narrative review. *International Journal of Environmental Research and Public Health*, *19*(7), 3909. https://doi.org/10.3390/ijerph19073909

Van Zomeren AH, Brouwer WH, Deelman BG. Attentional deficits: the riddles of selectivity, speed and alertness. In: *Closed head injury: Psychological, Social And Family Consequences*. Brooks N (Ed.). Oxford Medical Publications, Oxford, UK, 74–107 (1984).

Van Den Heuvel, M. W. H., Bodden, D., Moerbeek, M., Smit, F., & Engels, R. C. M. E. (2019). Dismantling the relative effectiveness of core components of cognitive behavioural therapy in preventing depression in adolescents: protocol of a cluster randomized microtrial. *BMC Psychiatry*, *19*(1). https://doi.org/10.1186/s12888-019-2168-6

Verweij, B. H., Muizelaar, J. P., Viñas, F. C., Peterson, P. E., Xiong, Y., & Lee, C. P. (2000). Impaired cerebral mitochondrial function after traumatic brain injury in humans. *Journal of Neurosurgery*, *93*(5), 815–820. https://doi.org/10.3171/jns.2000.93.5.0815

Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *PubMed*, *30*(6), 473–483.

Wen, H., Weymann, K., Wood, L. J., & Wang, Q. M. (2018). Inflammatory signaling in Post-Stroke fatigue and Depression. *European Neurology*, *80*(3–4), 138–148. https://doi.org/10.1159/000494988

Wilson, B. A., Winegardner, J., Van Heugten, C. M., & Ownsworth, T. (2017). *Neuropsychological rehabilitation: The International Handbook*. Psychology Press.

Wilson, B. A., & Betteridge, S. (2019). *Essentials of Neuropsychological Rehabilitation*. Guilford Publications.

Wise, E. A. (2004). Methods for Analyzing Psychotherapy Outcomes: A Review of Clinical Significance, Reliable Change, and Recommendations for Future Directions. *Journal of Personality Assessment*, *82*(1), 50-59. https://doi.org/10.1207/s15327752jpa8201_10

Worthington, E., Hawkins, L., & Lincoln, N. B., Drummond, A. (2017). The day-to-day experiences of people with fatigue after stroke: Results from the Nottingham Fatigue After Stroke study. *International Journal of Therapy and Rehabilitation*, *24*(10), 449–455. https://doi.org/10.12968/ijtr.2017.24.10.449

Wu, S., Chalder, T., Anderson, K., Gillespie, D., Macleod, M., & Mead, G. (2017). Development of a psychological intervention for fatigue after stroke. *PloS One*, *12*(8), e0183286. https://doi.org/10.1371/journal.pone.0183286

Wylie, G. R., & Flashman, L. A. (2017). Understanding the interplay between mild traumatic brain injury and cognitive fatigue: models and treatments. *Concussion*, *2*(4), CNC50. https://doi.org/10.2217/cnc-2017-0003

Wylie, G. R., Freeman, K., Thomas, A., Shpaner, M., O'Keefe, M. F., Watts, R., & Naylor, M. R. (2015). Cognitive Improvement after Mild Traumatic Brain Injury Measured with Functional Neuroimaging during the Acute Period. *PloS One*, *10*(5), e0126110. https://doi.org/10.1371/journal.pone.0126110

Xu, G.-Z., Li, Y.-F., Wang, M.-D., & Cao, D.-Y. (2017). Complementary and alternative interventions for fatigue management after traumatic brain injury: A systematic review. *Therapeutic Advances in Neurological Disorders*, *10*(5), 229–239. https://doi.org/10.1177/1756285616682675

Xu, X., Yang, M., Zhang, B., Niu, F., Dong, J., & Liu, B. (2021). Glucose metabolism: A link between traumatic brain injury and Alzheimer's disease. *Chinese Journal of Traumatology*, *24*(1), 5–10. https://doi.org/10.1016/j.cjtee.2020.10.001

Xu, G., Liu, Y., Wang, M., & Cao, D. (2017). Complementary and alternative interventions for fatigue management after traumatic brain injury: a systematic review. *Therapeutic Advances in Neurological Disorders*, *10*(5), 229–239. https://doi.org/10.1177/1756285616682675

Yanos, P. T., & Ziedonis, D. M. (2006). The Patient-Oriented Clinician-Researcher: Advantages and Challenges of being a Double Agent. *Psychiatric Services*, *57*(2), 249–253. https://doi.org/10.1176/appi.ps.57.2.249

Ymer, L., McKay, A., Wong, D., Frencham, K., Grima, N., Tran, J., Nguyen, S., Junge, M., Murray, J., Spitz, G., & Ponsford, J. (2021). Cognitive behavioural therapy versus health education for sleep disturbance and fatigue after acquired brain injury: A pilot randomised trial. *Annals of Physical and Rehabilitation Medicine*, *64*(5), 101560.

Zgaljardic, D. J., Durham, W. J., Mossberg, K. A., Foreman, J., Joshipura, K., Masel, B. E., Urban, R. J., & Sheffield-Moore, M. (2014). Neuropsychological and physiological correlates of fatigue following traumatic brain injury. *Brain Injury*, *28*(4), 389–397. https://doi.org/10.3109/02699052.2014.884242

2.12 Appendix B

2.12.1 Author guidelines for submission to the Journal of Neuropsychological Rehabilitation.

Instructions for authors

Thank you for choosing to submit your paper to us. These instructions will ensure we have everything required so your paper can move through peer review, production and publication smoothly. Please take the time to read and follow them as closely as possible, as doing so will ensure your paper matches the journal's requirements.

AUTHORSERVICES
Supporting Taylor & Francis authors

For general guidance on every stage of the publication process, please visit our Author Services website.

EDITINGSERVICES
Supporting Taylor & Francis authors

For editing support, including translation and language polishing, explore our Editing Services website

SCHOLARONE MANUSCRIPTS™

This journal uses ScholarOne Manuscripts (previously Manuscript Central) to peer review manuscript submissions. Please read the guide for ScholarOne authors before making a submission. Complete guidelines for preparing and submitting your manuscript to this journal are provided below.

This title utilises format-free submission. Authors may submit their paper in any scholarly format or layout. References can be in any style or format, so long as a consistent scholarly citation format is applied. For more detail see the format-free submission section below.

Single-case studies: submitted papers should follow SCRIBE guidelines (http://psycnet.apa.org/fulltext/2016-17384-001.html) and include a completed SCRIBE checklist together with the corresponding page number of the manuscript where the information is located.

Structure

Your paper should be compiled in the following order: title page; abstract; keywords; main text introduction, materials and methods, results, discussion; acknowledgments; declaration of interest statement; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figures; figure captions (as a list).

Word Limits

Please include a word count for your paper. There are no word limits for papers in this journal.

Style Guidelines

Please refer to these quick style guidelines when preparing your paper, rather than any published articles or a sample copy.

Please use American spelling style consistently throughout your manuscript. Please use single quotation marks, except where 'a quotation is "within" a quotation'. Please note that long quotations should be indented without quotation marks.

Alt Text

This journal is now including Alt Text (alternative text), a short piece of text that can be attached to your figure to convey to readers the nature or contents of the image. It is typically used by systems such as pronouncing screen readers to make the object accessible to people that cannot read or see the object, due to a visual impairment or print disability. Alt text will also be displayed in place of an image, if said image file cannot be loaded. Alt Text can also provide better image context/descriptions to search engine crawlers, helping them to index an image properly. To include Alt Text in your article, please follow our Guidelines.

Format-Free Submission

Authors may submit their paper in any scholarly format or layout. Manuscripts may be supplied as single or multiple files. These can be Word, rich text format (rtf), open document format (odt), or PDF files. Figures and tables can be placed within the text or submitted as separate documents. Figures should be of sufficient resolution to enable refereeing.

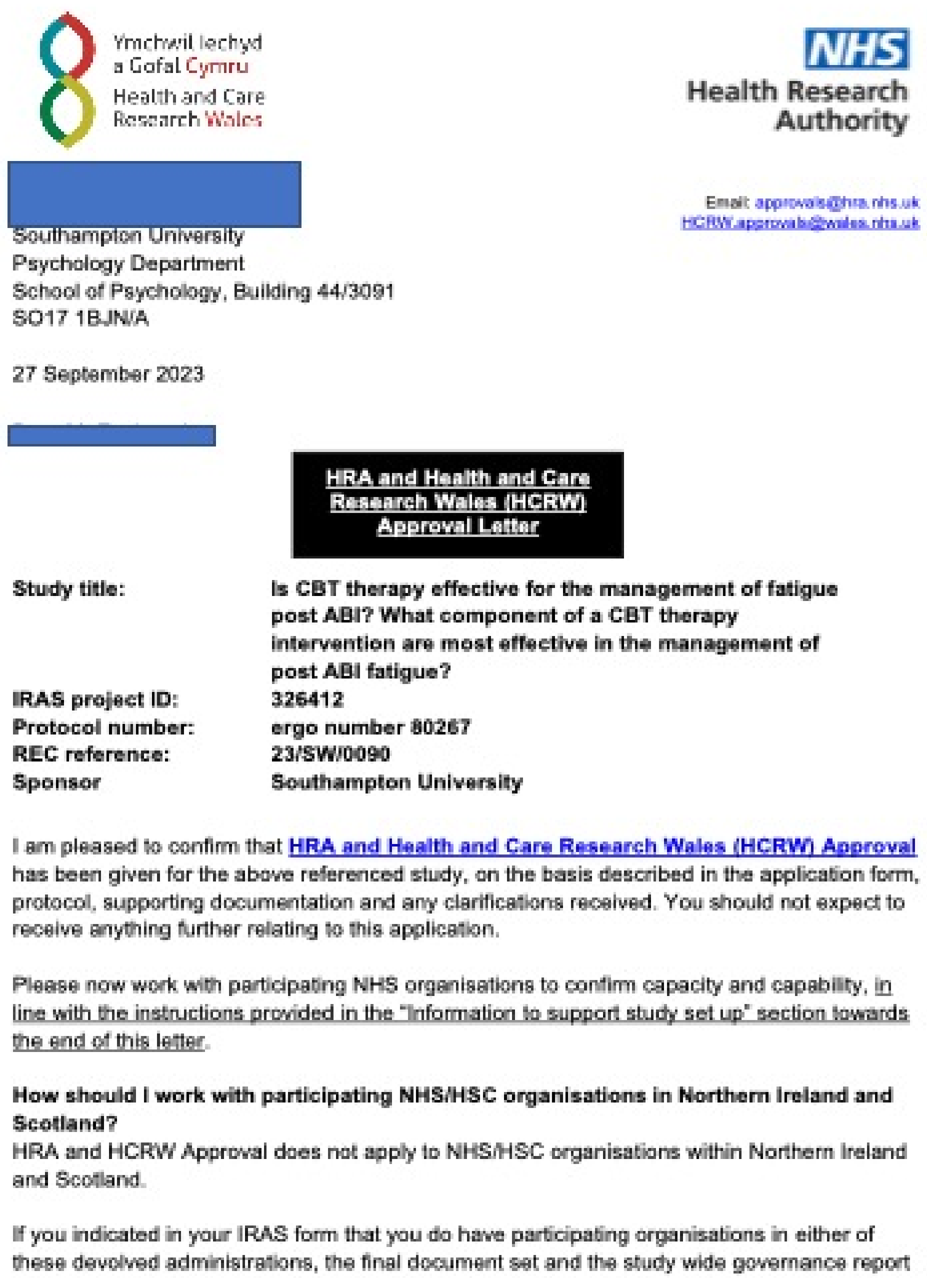
- There are no strict formatting requirements, but all manuscripts must contain the essential elements needed to evaluate a manuscript: abstract, author affiliation, figures, tables, funder information, and references. Further details may be requested upon acceptance.
- References can be in any style or format, so long as a consistent scholarly citation format is applied. Author name(s), journal or book title, article or chapter title, year of publication, volume and issue (where appropriate) and page numbers are essential. All bibliographic entries must contain a corresponding in-text citation. The addition of DOI (Digital Object Identifier) numbers is recommended but not essential.
- The journal reference style will be applied to the paper post-acceptance by Taylor & Francis.
- Spelling can be US or UK English so long as usage is consistent.

Note that, regardless of the file format of the original submission, an editable version of the article must be supplied at the revision stage.

Clinical Trials Registry

In order to be published in a Taylor & Francis journal, all clinical trials must have been registered in a public repository at the beginning of the research process (prior to patient enrolment). Trial registration numbers should be included in the abstract, with full details in the methods section. The registry should be publicly accessible (at no charge), open to all prospective registrants, and managed by a not-for-profit organization. For a list of registries that meet these requirements, please visit the WHO International Clinical Trials Registry Platform (ICTRP). The registration of all clinical trials facilitates the sharing of information among clinicians, researchers, and patients, enhances public confidence in research, and is in accordance with the ICMJE guidelines.

2.12.2 NHS Ethics Approval Letter.



Ymchwil Iechyd
a Gofal Cymru
Health and Care
Research Wales

NHS
Health Research
Authority

Email: approvals@hra.nhs.uk
HCRW.approvals@wales.nhs.uk

[redacted]
Southampton University
Psychology Department
School of Psychology, Building 44/3091
SO17 1BJN/A

27 September 2023

[redacted]

HRA and Health and Care Research Wales (HCRW) Approval Letter

Study title:	**Is CBT therapy effective for the management of fatigue post ABI? What component of a CBT therapy intervention are most effective in the management of post ABI fatigue?**
IRAS project ID:	**326412**
Protocol number:	**ergo number 80267**
REC reference:	**23/SW/0090**
Sponsor	**Southampton University**

I am pleased to confirm that HRA and Health and Care Research Wales (HCRW) Approval has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report

2.12.3 Debrief form

Debriefing Form

Study Title: CBT intervention for the management of fatigue post ABI.
Ethics/ERGO number: 80267

Thank you for taking part in our research project. Your contribution is very valuable and greatly appreciated.

Purpose of the study

The primary aim of this project was to evaluate the effectiveness of CBT therapy in the management of fatigue post brain injury.
Another aim was to evaluate which components of a "CBT package" can be most effective.

It is expected that fatigue symptoms will have reduced by the end of the intervention and that participants will be equipped with techniques to manage future fatigue. Your participation in the study will contribute to existing research around the effectiveness of CBT in the management of fatigue post ABI. Moreover, your participation can help the researchers pinpoint which sessions can be most effective in the management of fatigue post brain injury.

Please do not discuss this study, or show this debriefing form, to anyone until the study is complete, as this could affect the study results.

Now that you know the true purpose of our study and are fully informed, you may decide that you do not want your data to be used in this research. If you would like for your data to be removed from the study, please contact [redacted] by the end of February.

Confidentiality

Results of this study will not include your name or any other identifying characteristics.

Study results

If you would like to receive a copy of study findings when it is completed, please let us know by using the contact details provided on this form.

Further support

If taking part in this study has caused you discomfort or distress, you can contact the following organisations for support:

Further reading

If you would like to learn more about this area of research, you can refer to the following resources:

Nguyen, S. *et al.* (2017) ‘Cognitive behaviour therapy to treat sleep disturbance and fatigue after traumatic brain injury: A pilot randomized controlled trial’, *Archives of Physical Medicine and Rehabilitation*, 98(8). doi:10.1016/j.apmr.2017.02.031.

Further information

If you have any concerns or questions about this study, please contact [redacted] at [redacted] who will do their best to help.

If you remain unhappy or would like to make a formal complaint, please contact the Head of Research Integrity and Governance, University of Southampton, by emailing: [redacted] or calling: [redacted] Please quote the Ethics/ERGO number which can be found at the top of this form. Please note that if you participated in an anonymous survey, by making a complaint, you might be no longer anonymous.

Thank you again for your participation in this research.

2.12.4 WAI-SR

Table 2.4

Participants’ scores on WAI-SR overtime

WAI-SR	First Baseline	Second Baseline	Third Baseline
Participant 1	60	60	60
Participant 2	60	60	60
Participant 3	60	60	60
Participant 4	60	60	60

Note: WAI-SR scores overtime. Maximum score is 60 and lowest 0. A score of 60 would indicate excellent relationship with therapist, whereas a score of 0 would indicate a poor relationship.

2.12.5 SCRIBE Checklist

The Single-Case Reporting guideline In BEhavioural interventions (SCRIBE) 2016 Checklist

Item number	Topic	Item description	**Notes**
TITLE and ABSTRACT			
1	Title	Identify the research as a single-case experimental design in the title	Page 61
2	Abstract	Summarise the research question, population, design, methods including intervention/s (independent variable/s) and target behaviour/s and any other outcome/s (dependent variable/s), results, and conclusions	Page 61
INTRODUCTION			
3	Scientific background	Describe the scientific background to identify issue/s under analysis, current scientific knowledge, and gaps in that knowledge base	Page 62
4	Aims	State the purpose/aims of the study, research question/s, and, if applicable, hypotheses	Page 69
METHODS			
	DESIGN		
5	Design	Identify the design (e.g., withdrawal/reversal, multiple-baseline, alternating-treatments, changing-criterion, some combination thereof, or adaptive design) and describe the phases and phase sequence (whether determined *a priori* or data-driven) and, if applicable, criteria for phase change	Page 69
6	Procedural changes	Describe any procedural changes that occurred during the course of the investigation after the start of the study	N/A
7	Replication	Describe any planned replication	N/A
8	Randomisation	State whether randomisation was used, and if so, describe the randomisation method and the elements of the study that were randomized	Page 70
9	Blinding	State whether blinding/masking was used, and if so, describe who was blinded/masked	Page 70
	PARTICIPANT/S or UNIT/S		
10	Selection criteria	State the inclusion and exclusion criteria, if applicable, and the method of recruitment	Page 70
11	Participant characteristics	For each participant, describe the demographic characteristics and clinical (or other) features relevant to the research question, such that anonymity is ensured	Page 70
	CONTEXT		
12	Setting	Describe characteristics of the setting and location where the study was conducted	Page 70
	APPROVALS		
13	Ethics	State whether ethics approval was obtained and indicate if and how informed consent and/or assent were obtained	Page 76
	MEASURES and MATERIALS		
14	Measures	Operationally define all target behaviours and outcome measures, describe reliability and validity, state how they were selected, and how and when they were measured	Page 71
15	Equipment	Clearly describe any equipment and/or materials (e.g., technological aids, biofeedback, computer programs, intervention manuals or other material resources) used to measure target behaviour/s and other outcome/s or deliver the interventions	N/A
	INTERVENTIONS		
16	Intervention	Describe intervention and control condition in each phase, including how and when they were actually administered, with as much detail as possible to facilitate attempts at replication	Page 74
17	Procedural fidelity	Describe how procedural fidelity was evaluated in each phase	Page 77
	ANALYSIS		
18	Analyses	Describe and justify all methods used to analyse data	Page 75
RESULTS			
19	Sequence completed	For each participant, report the sequence actually completed, including the number of trials for each session for each case. For participant/s who did not complete, state when they stopped and the reasons	Page 77
20	Outcomes and estimation	For each participant, report results, including raw data, for each target behaviour and other outcome/s	Page 77
21	Adverse events	State whether or not any adverse events occurred for any participant and the phase in which they occurred	N/A
DISCUSSION			
22	Interpretation	Summarise findings and interpret the results in the context of current evidence	Page 92
23	Limitations	Discuss limitations, addressing sources of potential bias and imprecision	Page 96
24	Applicability	Discuss applicability and implications of the study findings	Page 94
DOCUMENTATION			
25	Protocol	If available, state where a study protocol can be accessed	Page 74
26	Funding	Identify source/s of funding and other support; describe the role of funders	Page 108