An Exploration of Insomnia, its Correlates and Psychological Treatment Options in Younger and Older Adults, and in Post Stroke Survivors

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Submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology

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Table of Contents

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Thank you to my family and friends, who have offered so much encouragement, sense of perspective and at times, much needed fun, throughout my years of studying. A special thank you to Kevan for always keeping things light-hearted and for the adventures outside of training.

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Forward

One of the requirements for the degree of Doctorate in Clinical Psychology, is to complete a research portfolio, comprising of a systematic review and a Major Research Project (MRP). The MRP is a study that the student develops, conducts, and then formally reports on, over the course of the 3-year degree.

Due to the COVID-19 pandemic and restrictions in participant recruitment, I was unable to proceed with my proposed MRP. In its place, this thesis contains my original MRP proposal, which has been updated and expanded to include a more detailed plan of how I would have analysed my MRP data, had the study gone ahead, as well as a brief critical appraisal of my planned methodology. My original MRP proposal, prior to changes, is in Appendix 4.

In place of the MRP, this thesis also contains a brief report analysing secondary data from a previous study that explored mental health prevalence in students. One of my supervisors, Dr Maria Gardani, was a co-author of this study and provided access to the original database for secondary analysis. The brief report explores insomnia and its correlates in a student population, which shares some similarity with my original MRP topic. It also focused on insomnia, albeit, within a stroke population.

The topic for the Systematic Review remained unchanged.

Chapter One: Does Cognitive Behavioural Therapy Reduce Insomnia Symptoms in Older Adults? A PRISMA Systematic Review

Chapter word count: 6141

Prepared in accordance with the guidelines for submission to SLEEP journal (Appendix 1.1)

Abstract

Background: Older adults tend to experience greater sleep related difficulties compared to younger adults. Despite this, non-pharmacological treatment options for insomnia, specifically tailored for the older adult population, have been somewhat under researched. This study systematically reviews evidence regarding the efficacy of Cognitive Behavioural Therapy for Insomnia (CBTI) within this age group.

Method: Five databases were searched and reference lists of obtained articles were hand searched. Seven studies were identified and rated using a modified version of the Clinical Trials Assessment Measures.

Results: Three papers were ranked as high quality, three as medium and one as low quality. Based on sleep diary outcomes, most participants experienced a significant improvement across sleep domains, post CBTI and at follow up, with four out of five studies reporting this. There were mixed results on the efficacy of CBTI on standardised outcome measures for insomnia and finally, two out of five studies found significant improvements post CBTI and at follow up, on actigraphy/polysomnography outcomes. There were key limitations across most papers including lack of randomisation to groups and convenience sampling.

Conclusion: Sleep diary outcomes suggest participants experienced a significant improvement in symptoms of insomnia post CBTI, with these improvements mostly maintained at follow up. Although this was somewhat supported on objective measures of sleep, the evidence was not as strong. Future research should focus on improving methodological quality.

MeSH terms and keywords:

Cognitive Behavioural Therapy, Sleep Initiation and Maintenance Disorders, Insomnia, Aging, Older Adults

Introduction

Insomnia: Definition and Prevalence

According to the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5; American Psychiatric Association, 2015) insomnia is a sleep-wake disorder, characterised by difficulty in initiating sleep, staying asleep or early morning awakening. As a result, individuals often experience day-time sleepiness, irritability, and difficulties with concentration. Adults over the age of 65, tend to experience more sleep related difficulties than their younger adult counterparts (Sateia, et al., 2017). Specific sleep problems often experienced by older adults include, reduced sleep efficiency, frequent night-time wakening and delayed sleep onset (Lichstein et al., 2013). Age related circadian cycle changes such as feeling more awake first thing in the morning can account for these sleep changes to some extent, in addition to older adults being more likely to experience physical health complaints (Ludwin, Bamonti & Mulligan, 2018).

Prevalence estimates of insomnia amongst older adults range from 9% to 25% (Brewster, Riegel & Gehrman, 2018). There is a common belief in society that 'older adults require less sleep' (Ancoli-Israel., 1997) and therefore when an older person voices a sleep difficulty, it may be viewed as a normal part of aging (Martin, Shochat & Ancoli-Israel, 2000). This view seems to be unfounded, with studies suggesting that although older adults may find it more difficult to achieve satisfactory sleep; their sleep needs are very similar to that of younger adults (Ludwin et al., 2018).

Insomnia Definition and Measurement

DSM-5 was released in 2013 and a major change from DSM-4, is the removal of the distinction between primary and secondary insomnia. This distinction was made to differentiate 'pure' independent insomnia from 'secondary' insomnia, whereby the insomnia occurs due to another mental or physical health condition. The removal of this distinction was due to a lack of evidence that treatment of the primary non-sleep disorder in turn, alleviates insomnia (Riemann et al, 2017).

Standardised outcome measures using self-report have been validated for assessing insomnia including; the Insomnia Severity Index (ISI; Bastien et al., 2001) and the Sleep Condition Indicator (SCI; Espie et al., 2014). Standardised outcome measures that are based on diagnostic criteria, are an easy and cost-effective method of collecting information and measuring treatment effects (Morin et al., 2004).

Objective measures of sleep such as polysomnography and actigraphy, are frequently used to obtain information on sleep/wake cycles. Polysomnography involves attaching electrodes to the body to monitor brain waves, breathing and movement. It is commonly used to diagnose sleep disorders (Sadeghniiat-Haghighi, Yazdi & Firoozeh, 2014). Actigraphy involves measuring movement over an extended period using a non-intrusive device, usually worn on the wrist. Actigraphy devices correlate highly with polysomnography (r=0.71) (Morgenthaler et al., 2007).

Interventions for Insomnia

Pharmacological Interventions

Treatments for older adult insomnia, have historically focussed on medication, predominantly non-benzodiazepine hypnotics, opiates, and SSRI's. Although helpful in the short term in reducing symptoms of insomnia, pharmacological interventions have not been found useful in the long term (Morin et al., 2004). Additionally, as the most used sleep medications are benzodiazepines, there is risk of dependency (Ludwin et al., 2018).

Cognitive Behavioural Therapy for Insomnia (CBTI)

CBTI has comparable short-term and long-term benefits to medication and is now recommended as the preferred treatment option for insomnia (Sateia et al., 2017). CBTI components with the strongest evidence base for efficacy include, stimulus control, cognitive restructuring, relaxation training and sleep restriction (Brewster et al., 2018). To be considered a CBTI intervention, at least two components should be included (Morin et al., 2004).

Numerous studies report positive outcomes for CBTI in younger adults (Ludwin et al., 2018: Wagley et al., 2012) and although considerably fewer in number, promising outcomes for the efficacy of CBTI in older adults have been reported (Morin et al., 2004: Alessi et al., 2016).

The most recent systematic review evaluating the efficacy of CBTI for older adult insomnia (Alessi et al., 2015) considered the efficacy of all non-pharmacological treatments for primary insomnia. They found moderate evidence in support of CBTI and weak evidence for bright light therapy and exercise. This review appeared to follow DSM-4 classification guidelines, whereby it only evaluated the efficacy of CBTI in the context of primary insomnia, excluding all secondary insomnia papers. It concluded that CBTI significantly improved sleep compared to no treatment.

Aims

This systematic review aims to update Alessi et al (2015) by reviewing papers published since their search in May 2014. Given that Alessi et al (2015) found weak evidence for bright light and exercise therapy it will only explore the efficacy of CBTI - the preferred treatment option for older adult insomnia (Sateia et al., 2017). Additionally, this review will follow DSM-5 classification guidelines for insomnia and therefore unlike Alessi et al (2015) will not exclude studies exploring secondary insomnia. Finally, it will only include studies with a treatment control arm and will explore the efficacy of CBTI on areas of sleep most impacted within the older adult population, namely, sleep efficiency (SE), sleep onset latency (SOL) and wake after sleep onset (WASO). Focusing solely on the efficacy of CBTI in older adults and on papers published since Alessi et al (2015) will provide an updated, more focussed and detailed exploration compared to that of a broader review, exploring numerous treatment options, across a larger time frame.

Research Questions

1. Is CBTI more effective in improving SE, SOL and WASO, compared to a control condition?
2. Is CBTI more effective in improving overall sleep quality and reducing insomnia severity symptoms compared to a control condition?

Methods

Search Strategy

PRISMA guidelines were followed throughout this systematic review. An electronic search of the following databases was conducted: Medline, Embase, CINAHL, PsychInfo and

ScienceDirect. Searches were limited to papers published in English between 1st May 2014 and 14th January 2020. Initial scoping searches were conducted to identify relevant search terms and these were finalised following discussion with a librarian (Appendix 1.2). Reference lists of selected articles were hand searched to identify other potential studies.

Study Selection

Duplicates were removed using RefWorks software. Titles and abstracts were screened, and eligible papers were then selected for full article review. The inclusion and exclusion criteria in Table 1 were used at each step in the review.

Table 1. Inclusion and exclusion criteria

Inclusion	Exclusion
• Published in English in a peer reviewed journal • Average age of participants is 65 years or over • Papers comparing the efficacy of CBTI to control condition • Participants meet DSM-5 diagnostic criteria for insomnia • Participants received a CBT intervention, comprising of at least two CBTI components: stimulus therapy, sleep restriction, relaxation training and cognitive restructuring. • Papers published after 14 May 2014	• Studies focussing on medical risk factors or prevalence of insomnia • Average age of participants is less than 65 years or average age is not provided • Studies including participants with cognitive impairment • Studies with no control arm • No measurement of the efficacy of CBTI • No outline of which CBTI components (minimum of 2) were incorporated into the intervention • Review papers • Case studies • Book chapters • Conference abstracts

	• Reports

Data Extraction

An extraction tool was developed and piloted to ensure significant information from each article was collected (see Appendix 1.3). The search, screening and data extraction was conducted by the first author alone.

Quality Rating Scale & Criteria

The quality of included studies was rated using a modified version of The Clinical Trials Assessment Measure (CTAM; Tarrier & Wykes, 2004). The CTAM has high internal consistency (Cronbach $\alpha = 0.697$) and external validity ($p = .93$, $P < .001$) (Wykes et al., 2007), and was developed by extracting key features from CONSORT (CONsolidated Standards of Reporting Trials) which were designed to improve reporting of randomised control trials and to allow readers to evaluate with ease, the quality and validity of studies (Schulz, Altman & Moher, 2010). Ratings of 0, 1, 3, 4, 5, 6 or 10 can be allocated for each item. For this review, the CTAM was altered to include items specific to the measurement of insomnia and the efficacy CBTI. The modified CTAM consisted of 26 items covering six areas of trial design, with a maximum score of 147 being available (see Appendix 1.4). Items and subsequent ratings were weighted according to their relevance to the research questions. A score of 72 or less out of 147 (49%), was considered low quality. A score of between 73 and 109 (50-74%) was considered moderate quality and a score of 110 (75%) or more was considered high quality.

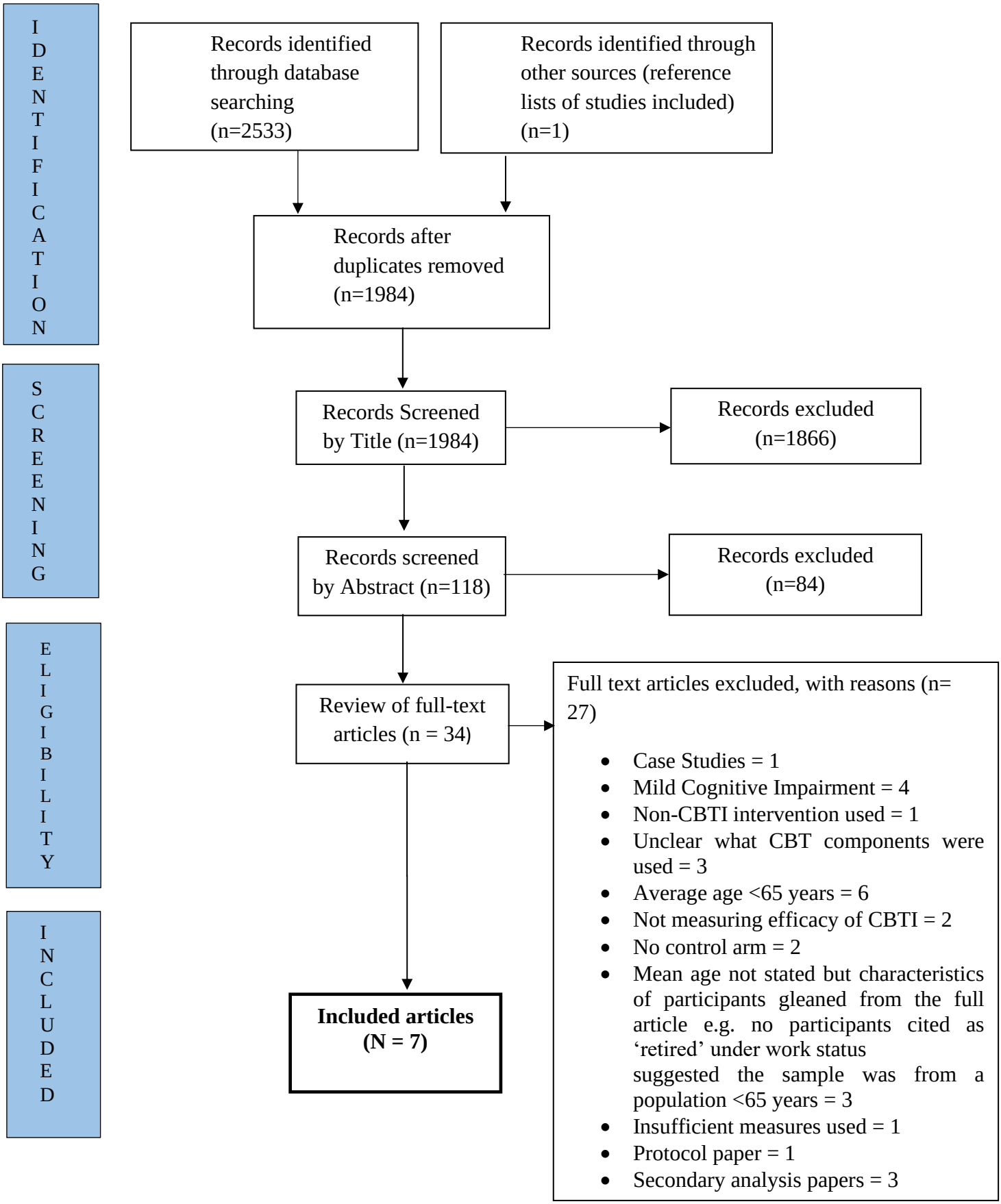
A Clinical Psychologist, unrelated to the study and with experience in systematic review methodology and paper quality rating, was given the list of papers meeting the inclusion criteria to review quality, for inter rater reliability purposes. They randomly selected three of these papers and scored them against the CTAM. Agreement of final scores on the CTAM was high 96% and therefore it was deemed unnecessary to co-rate additional studies. Differences in ratings were resolved via discussion.

Results

Study Selection

The literature search produced 2534 papers, with the removal of duplicates leaving 1984. The titles of the remaining articles were compared to the inclusion and exclusion criteria, excluding 1866. The abstracts of the remaining 118 articles were compared to the inclusion and exclusion criteria leaving 34 papers deemed suitable for full text review and following this, 7 papers were considered eligible for inclusion. Hand searches of references identified one paper. Figure 1 outlines the paper selection process.

Figure 1: PRISMA Flow diagram showing the details of the systematic search process



Results

Table 2: Summary of studies included in the systematic review, including overall percentage achieved on the CTAM. A breakdown of scores for each study, across all 6 CTAM subscales, can be found in Appendix 1.5.

Study, Country & Quality rating	**Sample Characteristics**	**Description of Intervention (N=Participant Number)**	**Areas of sleep measured, and outcome measures used**	**Effect Sizes/ Statistical Outcomes**
1. McCrae et al (2018) USA 79% - High	62 participants 68% females Age range: 65+ (Mean = 69.4, SD = 7.72).	RCT (2 groups) BBTI (N=32) – consisting of relaxation, stimulus control, sleep hygiene and sleep restriction SMC (N=30) – social conversation & sleep diary completion Groups delivered one to one across 4, weekly, 1-hour sessions Data recorded at baseline, post treatment and 3 months	SOL, WASO, SE, Sleep Diaries Actigraphy	**Sleep Diaries** ***BBTI vs SMC*** **SOL - Significant** difference post treatment d = 0.26, 3 months d = 0.18 **SE - Significant** difference post treatment d = 0.14, 3 months d = 0.23 **WASO - Significant** difference post treatment d = 0.16, 3 months d = 0.32 **Actigraphy** ***BBTI vs SMC*** **No significant** difference in **WASO, SOL, or SE** post treatment or at 3 months follow up.
2. Alessi et al (2016) 76% - High	159 participants 97% males	RCT (3 groups)	SOL, WASO, SE, Sleep diaries Actigraphy	***Sleep Diaries*** ***CBTI vs SEC*** **SOL - Significant** difference post treatment d= -0.55 6 months d = -0.37 & 12-months d = -0.41

USA	Age Range: 60+ (Mean = 72.2, SD = 7.7)	CBTI (delivered one to one, N=53) – cognitive therapy, stimulus control, sleep hygiene and sleep restriction CBTI (delivered in a group setting, N=52) – content as above SEC (N=54) – one to one format, sleep education All groups received 5 weekly, 1-hour sessions. Data recorded at baseline, post treatment, 6 months & 12 months Group and individual CBTI results were combined	PSQI ISI	**WASO - Significant** difference post treatment d= 0.36 but **NOT** at 6 months d = -0.21- or 12-months d = 0.04 **SE - Significant** difference post treatment d= 0.68, 6 months d = 0.43 & 12 months d = 0.35 **<u>Actigraphy</u>** (only SE outcomes) **No significant** difference in **SE** between groups, post treatment or at 6 or 12 months **<u>SQ & Insomnia Severity</u>** ***Between Groups*** **PSQI - Significant** differences post treatment d=0.98, 6 months d= 0.69, 12 months d = 0.63 **ISI - Significant** differences post treatment d = 0.85, 6 months d = 0.74, 12 months d = 0.54
3. Irwin et al (2014) 76% - High USA	123 participants 72% female Age Range: 55 - 85 (Mean Age = 65.7, SD = 6.1)	RCT (3 groups) CBTI (N =50) - stimulus control, relaxation, mood enhancement and sleep restriction TCC (N=48) – movement therapy SS (N=25) - education on sleep and ageing	SE, WASO, SOL Sleep diaries Polysomnography PSQI	**<u>Sleep Diaries</u>** ***CBTI vs SS***** SE - Significant difference at 4 months d = 3.12- and 16-months d = 2.31 SOL - Significant difference at 4 months d = 2.33- and 16-months d = 2.52 WASO - Significant difference at 4 months d = 3.48- and 16-months d = 2.25

		2-hour weekly sessions, in groups of 7 – 10 participants, over 4 months Data recorded at baseline, 4, 7 and 16 months		**<u>Polysomnography</u>** *(only 4 months follow up)* ***CBTI vs SS*** **No Significant** difference for **SE, WASO or SOL** Pre vs 4 months d = 0.14 **<u>SQ & Insomnia Severity</u>** **PSQI**** CBT vs SS **Significant** differences at 3 months d = 0.79 and 16-months d = 0.81
4. Martin et al (2017) 69% - Medium USA	42 participants 93% males Age Range: 60+ (Mean age = 77.1, SD = 9.9)	RCT (2 groups) SIP (N=21) – sleep hygiene, sleep restriction, stimulus control IC (N=21) – information on age and sleep Both groups received one to one, 4, weekly, 45-minute sessions Data recorded post treatment and at 4 months	SE, WASO ISI PSQI Actigraphy	**<u>Actigraphy</u>** ***SIP vs IC*** **SE:** S**ignificant** difference post intervention (p=0.007) and at 4 months (p=0.02) **WASO:** S**ignificant** difference post intervention (p=0.02) and at 4 months (p=0.03) **<u>SQ & Insomnia Severity</u>** ***Between Groups*** **PSQI: No significant** difference post treatment or at follow up

				ISI: No significant post treatment or at follow up Effect sizes could not be calculated
5. Tanaka et al (2019) 63% - Medium Japan	49 participants 73% females Age Range: unknown (Mean age = 69.7, SD = 8.1)	RCT (2 groups) CBTI (N= 23) – stimulus control, sleep hygiene, sleep restriction, education, relaxation WLC (N=23) – completed PSQI at baseline and follow up 4 weekly sessions, (one 60-minute group session, one 45-minute individual session and two 20 minutes follow up) Data collected at baseline and 3 months	Sleep quality PSQI	**<u>SQ – PSQI</u>** ***CBTI vs WLC****** **No Significant** differences at 3 months p=.16, d= 0.22
6. Sadler et al (2018) 62% - Medium Australia	72 participants 56% females Age Range: 65+ (Mean age = 75, SD = 7.0)	RCT (3 groups) CBTI (N=24) – stimulus control, sleep restriction, sleep hygiene and relaxation CBTI+ (N=25) – as above but with the addition of depression specific strategies	SOL, WASO, SE Sleep Diaries ISI	**<u>Sleep Diaries</u>** ***CBTI vs PCG*** **SOL**: S**ignificant** difference at 8 weeks d = 1.85 but **not** at 20 weeks. **SE:** S**ignificant** difference at 8 weeks d = 1.85 but **not** at 20 weeks. **WASO: Significant** difference at 8 weeks d = 1.02 but **not** at 20 weeks.

		PCG (N=23) – education on sleep, insomnia and depression All groups received, 8, weekly, 60-90-minute, group sessions Data collected at baseline, 8 weeks and 20 weeks		**<u>SQ & Insomnia Severity</u>** ***ISI*** **Significant** difference at 8 weeks, d= 1.87 and at 20 weeks d= 2.40
7. Dolu et al (2018) 46% - Low Turkey	52 participants 52% females Age Range: 65 - 96 (Mean age = 79.8, SD = 7.4)	(Non RCT) - Participants <u>allocated</u> to either: SP (N=26) – sleep restriction, sleep hygiene, stimulus control, education. Participants received 4, weekly, one to one, 1-hour sessions TAU (N=26) - participants received regular nursing services Data collected at baseline, 8 and 12 weeks	SOL, SE, WASO Sleep diaries PSQI Actigraphy	**<u>Sleep Diaries</u>** ***SP vs TAU*** **SOL – No significant** difference 8 weeks d = < 30 or at 12 weeks d = >50 **WASO –** no data provided **SE - No significant** difference at 8 weeks d = <30 or at 12 weeks d = >80 **<u>Actigraphy</u>** ***SP vs TAU*** **SOL - No significant** difference at 8 weeks d = <30 or at 12 weeks d = <30 **SE - Significant** difference at 8 weeks d = >80 and at 12 weeks d =>30 **WASO - No significant** difference at 8 weeks d = <30 but a **significant** difference at 12 weeks d = <30 **<u>SQ</u>**

				Between Groups **PSQI - No significant** difference at 8 weeks d = <30 or 12 weeks d = (0.50 – 0.79)

KEY: PSQI = Pittsburgh Sleep Quality Index; SE = sleep efficiency; WASO = wake after sleep onset; SOL = sleep onset latency; BBTI = brief behavioural treatment for insomnia; CBTI = cognitive behavioural therapy for insomnia; SMC = sleep monitoring control; SEC = sleep education control; TCC = tai-chi chih; SS = sleep seminar; SIP = sleep intervention programme; IC = information control; SQ = Sleep Quality; PEC = psychoeducation control; WLC = waiting list control; SP = sleep programme; TAU = treatment as usual; ISI = insomnia severity index ** = effect size calculations completed by author of this review

Brief Summary of Individual Studies

'High quality' papers

McCrae et al (2018) – 79%

This study examined the effects of a BBTI on symptoms of insomnia, mood, and cognitive functioning. A power calculation took place prior to recruitment with the study achieving the intended participant numbers. Participants were recruited via community advertising and had a very high level of education attainment, with 60% having at least 16 years of education. The randomisation process to group allocation was not described. CBT training for therapists was not clearly described and the follow-up period was short (3 months). The BBTI intervention was manualised and described in sufficient detail for replication. 16% of participants dropped out before the end of the intervention and a further 13% were lost to 3 follow-up. Baseline insomnia duration was significantly different between groups and was controlled for with ANCOVA.

Alessi et al (2016) – 76%

This study evaluated the efficacy of a new CBTI programme designed for use by non-sleep clinicians. A power calculation suggested a sample of at least 150 participants would be required to test for significant differences (power = 80%). A strength of this study was its randomisation process, which was carried out independently and clearly documented. Therapist training comprised of attending either a 2-day workshop on CBTI or 6 CBTI webinar sessions, of which the length and content was unclear. The intervention was manualised but lacked sufficient detail to be replicated. It was not clear if outcome assessments were completed

by independent assessors. All participants who commenced the intervention were included in the final analysis.

Irwin et al (2014) – 76%

This study investigated the efficacy of CBT vs Tai chi chih vs a sleep control group in reducing symptoms of insomnia, depression, and inflammation. Participants were recruited via community advertising. The study scored full marks for 'allocation', offering a clear account of the randomisation process. It was not clear whether assessments were carried out by independent assessors and similarly, although assessments were carried out blind, the procedure was not documented. The manualised intervention was not described adequately to replicate. Therapists were suitably trained to deliver CBTI and adherence to treatment protocol was measured via observations. Subject retention for the CBTI group was high.

'Medium quality' papers

Martin et al (2017) – 69%

The aim of the study was to determine the efficacy of a sleep intervention programme compared to an information only control among older adult veterans. The randomisation process was not described, and assessments were carried out by assessors not involved in the study. The CBT intervention was appropriate, manualised, and clearly described for the purposes of replication. Participant retention was high and an intention to treat analysis was documented. Therapist adherence to the treatment protocol was monitored, via frequent supervision and direct observations.

Tanaka et al (2019) – 63%

This study aimed to determine whether brief CBTI could reduce symptoms of insomnia and depression in older adults. Randomisation was carried out by an independent researcher however it was unclear who completed outcome assessments. Similarly, the CBT intervention was well documented however the intervention was not manualised and delivery open to interpretation. CBT training was insufficient with therapists attending a '2-day CBT training course'.

Sadler et al (2018) – 62%

The study aimed to establish whether CBTI was effective in reducing symptoms of insomnia and depression in older adults. Participants were community mental health team attendees. A power analysis was completed however the study failed to recruit the number of participants set out. A strength of this study was its allocation procedure, which was carried out by an independent researcher. No intention to treat analysis was documented and therefore it was unclear whether all randomised participants were included in the analysis. The detailed, manualised CBTI intervention was carried out by therapists who had at least 1 years' experience. Therapist adherence to treatment protocol was suitably monitored.

'Low quality' papers

Dolu et al (2018) – 46%

This non-randomised study investigated the effects of a sleep programme for insomnia and depression in care home residents. Educational attainment was high amongst participants, with around 80% obtaining high school education or higher. It was unclear who conducted outcome assessments and therefore open to potential bias. The paper did not outline whether the sleep programme was manualised and its means of measuring fidelity to treatment were not adequate. The intervention was described in enough detail for replication. Nurse's previous CBT experience was not documented. Although the participant drop-out rate was low, an intention to treat analysis was not completed.

Overall Findings

All but one study (Dolu et al, 2018) found significant reductions in insomnia post intervention on at least one sleep outcome measure. The difference in findings by Dolu et al (2018) could potentially be attributed to a quality problem, since it was rated lowest quality overall or could also be related to other factors including 1) it being the only study to use care home residents as participants and whom therefore may respond differently to CBTI and 2) it had the highest mean age of participants of all studies (79 years) and possibly older participants may not respond as well to CBTI. Effect sizes post treatment varied from small to large across studies and similarly at follow up. Martin et al (2017) acknowledged that their study was underpowered to detect any meaningful change although recorded significant improvement post intervention on actigraphy data. This was the only study, other than Dolu et al (2018) to find any significant post intervention effects on actigraphy devices.

Although some studies had a significantly higher ratio of males or females in their participant sample e.g. Alessi et al (2016) had 97% males, when combined there was a general gender balance across reviewed studies, with no gender and outcome trend evident between studies. Those studies finding significant effects at follow up (McCrae et al, 2018; Alessi et al, 2016 &

Irwin et al, 2016) tended to have a younger mean age of participants. Additionally, Martin et al (2017), Sadler et al (2016) and Dolu et al (2018) had a higher mean age of participant samples and also had a significantly higher proportion of participants either residing in assisted living accommodation or in a care home environment.

Follow up periods ranged between two and sixteen months with no apparent relationship between length of follow up and effect size observed. Additionally, each study had a considerably high ratio of white participants, ranging from 71% to 83%.

Overall, there were differences across studies in how outcomes were measured. Some studies used three modes of measurement whilst others used only one and therefore as a result direct comparison of specific outcomes between studies is limited.

Discussion

Although the number of studies published since the Alessi (2015) review is modest, the findings of this systematic review support the use of CBT and its components for older adult insomnia. Compared to treatment as usual and sleep seminar control groups, CBTI improved 1) sleep efficiency 2) wake after sleep onset and 3) sleep onset latency in 4/5 studies using sleep diaries. Of the four studies finding positive treatment effects on sleep diaries, three were of high quality on the CTAM which increases the confidence of these findings.

Of the five studies that used polysomnography and actigraphy as outcomes, only two studies (Martin et al, 2017; Dolu et al, 2018) found significant change in sleep efficiency post CBTI and these were of medium and low quality. The study by Martin et al (2017), which was lacking in statistical power, found significant reductions in wake after sleep onset and neither study reported significant treatment effects for sleep onset latency post CBTI. Given that only 2/5 studies found significant treatment effects across some but not all sleep domains on

actigraphy/polysomnography outcomes, the efficacy of CBTI was much smaller on objective measures compared to subjective measures.

There was variation across studies on sleep quality and insomnia severity outcomes post CBTI. Two high quality studies (Alessi et al, 2016; Irwin et al, 2014) found a significant reduction in PSQI scores post treatment. A third, medium quality study (Tanaka et al, 2019) found no significant difference pre to post treatment. Similarly, two out of three studies (Alessi et al, 2016; Sadler et al, 2016), which were of high and medium quality respectively, found a significant reduction in ISI scores post treatment. The study that found no significant difference (Martin et al, 2017) was of medium quality. As significant treatment outcomes were found on the PSQI and ISI on 4/6 occasions, and by some high-quality papers, the findings overall support the efficacy of CBTI in older adults.

Overview of Methodology

With regards to participant samples, five studies used a convenience sample, with three of these studies inviting participants to respond to community advertisements. Participants who volunteer to participate in health-related studies are more likely to be female, highly educated, of higher socio-economic status and more interested in health and wellbeing (Salkind, 2010) and hence, may not have been representative of the general population.

Control groups were included in all studies comprising a mixture of treatment as usual (TAU) controls who received no additional input and sleep education/seminar 'active' control groups who received information around sleep. Unlike TAU, active control groups control for improvements caused by factors other than the experimental treatment itself, making them the methodologically stronger option. When both groups have similar expectations of

improvement, active control groups control for possible placebo effect related improvements (Boot et al, 2013). Additionally, since participants engage in tasks during the intervention period, usually with a therapist, improvements solely due to a strong therapeutic relationship are also controlled for (Leahy, 2008).

Only two studies included a follow up of at least 6 months (Alessi et al, 2016; Irwin et al, 2014), both of which were of high quality and found maintenance of improvements across most sleep domains at 6, 12 and 16 months follow up, providing support for longer-term benefits of CBTI.

Five studies followed manualised protocols, increasingly the likelihood of consistency and reliability that the intervention itself was accountable for treatment effects. Only 3 studies provided enough information for studies to be replicated, making it difficult to repeat studies and test reliability of results. Moreover, only 3 studies cited adequately trained therapists for intervention delivery, with the remaining studies either not providing enough information on therapist background or not stipulating whether therapists had CBT specific qualifications. This raises questions about the validity of the interventions as CBT.

Findings of this review are like those by Alessi et al (2015) who on the basis of sleep diaries, found moderate quality evidence for the efficacy of CBTI in older adults for SE, SOL and WASO. Of the seven CBT studies reviewed by Alessi et al (2015), only one study provided an effect size for the CBT intervention and therefore the overall magnitude of the effect was unclear. This is considerably different to the present review where six of the seven included studies either reported or offered enough information to calculate effect sizes, with large effects being found across some high-quality studies and subsequently offers further support for the efficacy of CBTI amongst older adults. Alessi et al (2015) did not review actigraphy/polysomnography measures. An earlier review (Montgomery & Dennis, 2004)

considered both objective and subjective measures and overall found support for the efficacy of CBTI, as in the present review. Montgomery and Dennis (2004) also found inconsistency between subjective and objective measures; participants tended to report greater improvements on subjective rather than objective measures of sleep, post CBTI intervention. These findings are consistent with those by Morin, Cuthbert & Schwartz (1994), who discussed that the magnitude of perceived sleep improvement often tends to be greater in subjective measures.

The findings of this review are similar to those studies carried out within a younger adult population. Trauer et al (2015) carried out a meta-analysis on the efficacy of CBTI in younger adults. They found similar results to this review where evidence supported the efficacy of CBTI with moderate effects, across sleep domains. Similar to the older adult population, the magnitude of effects tended to be greater on subjective measures amongst younger adults.

The efficacy of CBTI found in this review is at least equal to or superior to outcomes found for pharmacological treatments amongst older adults. A meta-analysis by Glass et al (2005) found sedative use to significantly improve sleep in older adults but identified the magnitude of effects to be small. Additionally, they found that individuals receiving sedatives were significantly more likely to experience an adverse event e.g. falling. Given the risks associated with pharmacological interventions, CBTI may be a preferable treatment option within this population.

Strengths and Limitations of this Review

This is the first study to systematically review CBTI in an older adult population since Alessi et al (2015). A recognised quality assessment tool for methodological evaluation was used to identify strengths and weaknesses within the literature. The method by which studies were evaluated in this review, is subjective in nature and therefore open to differing interpretations and possible bias, despite the inclusion of an independent rater. Additionally, the inclusion of

second raters at the screening and data extraction stages would have increased reliability of results obtained.

Suggestions for future research

Further studies are needed to strengthen the evidence base and should 1) include longer follow up periods to establish the long term efficacy of the CBTI intervention and whether improvements in symptoms were maintained 2) carry out randomisation independently of the research team to eliminate possible bias in group assignment and enhance reliability of results found 3) ensure outcome assessments are marked blind and independently, to minimise potentially bias scoring 4) include adequately trained therapists to increase likelihood of fidelity to the evidence base and validity of results obtained 5) should recruit participants from a wider population to increase generalisability of results obtained 6) use active controls to increase the likelihood that changes observed were due to the intervention and not placebo or other confounding effects.

Conclusion

Despite participants experiencing a subjective improvement in sleep, evidence for this on objective measures is weak. Methodological limitations in the literature, in relation to CONSORT guidelines (Schulz, Altman & Moher, 2010) prevent firm conclusions being made but given reports of improvement across most sleep domains post treatment and at follow up in several high quality studies, CBTI can tentatively be recommended for older adult insomnia.

For 'Practice Points & Research Agenda' see Appendix 1.6

References

Alessi, C., & Vitiello, M. V. (2015). Insomnia (primary) in older people: non-drug treatments. *BMJ clinical evidence*, *2015*.

Alessi, C., Martin, J. L., Fiorentino, L., Fung, C. H., Dzierzewski, J. M., Rodriguez Tapia, J. C., ... & Mitchell, M. N. (2016). Cognitive behavioral therapy for insomnia in older veterans using nonclinician sleep coaches: randomized controlled trial. *Journal of the American Geriatrics Society*, *64*(9), 1830-1838.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.

Ancoli-Israel, S. (1997). Sleep problems in older adults: putting myths to bed. *Geriatrics (Basel, Switzerland)*, *52*(1), 20-30.

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep medicine*, *2*(4), 297-307.

Boot, W. R., Simons, D. J., Stothart, C., & Stutts, C. (2013). The pervasive problem with placebos in psychology: Why active control groups are not sufficient to rule out placebo effects. *Perspectives on Psychological Science*, *8*(4), 445-454.

Brewster, G. S., Riegel, B., & Gehrman, P. R. (2018). Insomnia in the Older Adult. *Sleep medicine clinics*, *13*(1), 13–19.

Dolu, I., & Nahcivan, N. O. (2019). Impact of a nurse-led sleep programme on the sleep quality and depressive symptomatology among older adults in nursing homes: A non-randomised controlled study. *International journal of older people nursing*, *14*(1), e12215.

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ open*, *4*(3).

Glass, J., Lanctôt, K. L., Herrmann, N., Sproule, B. A., & Busto, U. E. (2005). Sedative hypnotics in older people with insomnia: meta-analysis of risks and benefits. *Bmj*, *331*(7526), 1169.

Irwin, M. R., Olmstead, R., Carrillo, C., Sadeghi, N., Breen, E. C., Witarama, T., ... & Bootzin, R. (2014). Cognitive behavioral therapy vs. Tai Chi for late life insomnia and

inflammatory risk: a randomized controlled comparative efficacy trial. *Sleep*, *37*(9), 1543-1552.

Leahy, R. L. (2008). The therapeutic relationship in cognitive-behavioral therapy. *Behavioural and Cognitive Psychotherapy*, *36*(6), 769-777.

Lichstein, K. L., Scogin, F., Thomas, S. J., DiNapoli, E. A., Dillon, H. R., & McFadden, A. (2013). Telehealth cognitive behavior therapy for co-occurring insomnia and depression symptoms in older adults. *Journal of Clinical Psychology*, *69*(10), 1056-1065.

Ludwin, B. M., Bamonti, P., & Mulligan, E. A. (2018). Program evaluation of group-based cognitive behavioral therapy for insomnia: A focus on treatment adherence and outcomes in older adults with co-morbidities. *Clinical gerontologist*, *41*(5), 487-497.

Martin, J., Shochat, T., & Ancoli-Israel, S. (2000). Assessment and treatment of sleep disturbances in older adults. *Clinical Psychology Review*, *20*(6), 783-805.

Martin, J. L., Song, Y., Hughes, J., Jouldjian, S., Dzierzewski, J. M., Fung, C. H., ... & Alessi, C. A. (2017). A four-session sleep intervention program improves sleep for older adult day health care participants: results of a randomized controlled trial. *Sleep*, *40*(8).

McCrae CS, Curtis AF, Williams JM, et al. Efficacy of brief behavioral treatment for insomnia in older adults: examination of sleep, mood, and cognitive outcomes. Sleep Med. 2018;2(51):153–166.

Montgomery, P., & Dennis, J. (2004). A systematic review of non-pharmacological therapies for sleep problems in later life. *Sleep medicine reviews*, *8*(1), 47-62.

Morgenthaler, T. I., Lee-Chiong, T., Alessi, C., Friedman, L., Aurora, R. N., Boehlecke, B., ... & Owens, J. (2007). Practice parameters for the clinical evaluation and treatment of circadian rhythm sleep disorders. *Sleep*, *30*(11), 1445-1459.

Morin, C. M., Bastien, C., Guay, B., Radouco-Thomas, M., Leblanc, J., & Vallières, A. (2004). Randomized clinical trial of supervised tapering and cognitive behavior therapy to facilitate benzodiazepine discontinuation in older adults with chronic insomnia. *American Journal of Psychiatry*, *161*(2), 332-342.

Morin, C. M., Culbert, J. P., & Schwartz, S. M. (1994). Nonpharmacological interventions for insomnia: a meta-analysis of treatment efficacy. *Arn J*, *151*, 1172-1180.

Riemann, D., Baglioni, C., Bassetti, C., Bjorvatn, B., Dolenc Groselj, L., Ellis, J. G., ... & Hertenstein, E. (2017). European guideline for the diagnosis and treatment of insomnia. *Journal of sleep research*, *26*(6), 675-700.

Sadeghniiat-Haghighi, K., Yazdi, Z., & Firoozeh, M. (2014). Comparison of two assessment tools that measure insomnia: the insomnia severity index and polysomnography. *Indian journal of psychological medicine*, *36*(1), 54.

Sadler, P., McLaren, S., Klein, B., Harvey, J., & Jenkins, M. (2018). Cognitive behavior therapy for older adults with insomnia and depression: a randomized controlled trial in community mental health services. *Sleep*, *41*(8), zsy104.

Salkind, N. J. (2010). *Encyclopedia of research design* (Vols. 1-0). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288

Schulz, K. F., Altman, D. G., & Moher, D. (2010). CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials.

Sateia, M. J., Buysse, D. J., Krystal, A. D., Neubauer, D. N., & Heald, J. L. (2017). Clinical practice guideline for the pharmacologic treatment of chronic insomnia in adults: an American Academy of Sleep Medicine clinical practice guideline. *Journal of Clinical Sleep Medicine*, *13*(02), 307-349.

Tanaka, M., Kusaga, M., Nyamathi, A. M., & Tanaka, K. (2019). Effects of Brief Cognitive Behavioral Therapy for Insomnia on Improving Depression Among Community-Dwelling Older Adults: A Randomized Controlled Comparative Study. *Worldviews on Evidence-Based Nursing*, *16*(1), 78-86.

Tarrier, N., & Wykes, T. (2004). Is there evidence that cognitive behaviour therapy is an effective treatment for schizophrenia? A cautious or cautionary tale?. *Behaviour Research and Therapy*, *42*(12), 1377-1401.

Trauer, J. M., Qian, M. Y., Doyle, J. S., Rajaratnam, S. M., & Cunnington, D. (2015). Cognitive behavioral therapy for chronic insomnia: a systematic review and meta-analysis. *Annals of internal medicine*, *163*(3), 191-204.

Wykes, T., Steel, C., Everitt, B., & Tarrier, N. (2008). Cognitive behavior therapy for schizophrenia: effect sizes, clinical models, and methodological rigor. *Schizophrenia bulletin*, *34*(3), 523-537.

Chapter 2: The Effectiveness of a Brief Behavioural Intervention, in the management of Post Stroke Insomnia: A Single Case Experimental Design (Updated and Expanded Research Proposal)

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Abstract

Background**:** Insomnia is a frequently occurring post-stroke symptom, with approximately one third of sufferers experiencing sleep problems 12 months after stroke. Cognitive Behavioural Therapy (CBT), has been found to significantly reducing symptoms of insomnia within the general population. Few studies, however, have been carried out exploring the efficacy of psychological interventions for post stroke insomnia.

Aims**:** This study aims to explore the efficacy of a brief behavioural treatment intervention for insomnia (BBTI) in reducing symptoms of insomnia, following a stroke. Additionally, it will aim to explore the retention and recruitment rate of participants.

Methods**:** Participants (N=6) will be recruited from NHS Stroke Psychology Outpatient Services and from a local charity. The study will take the form of a multiple baseline ABA single case experimental design (SCED), whereby multiple measurements of participant sleep efficiency, sleep duration and sleep onset latency will be recorded during the baseline and intervention phases. Participants meeting the inclusion criteria will complete standardised outcome measures for sleep and mood before being randomly allocated to 1 of 6 differing duration baseline phases (ranging from 5 – 20 days). On completion of the baseline phase, participants will then complete the 4-week BBTI intervention. Finally, participants will complete a 7-day post-intervention baseline phase. Participants will be invited to complete sleep diaries throughout.

Applications**:** Given the high incidence of post-stroke insomnia, if successful, the BBTI could help a large proportion of stroke survivors achieve more satisfactory sleep. Additionally, a larger scale research study, incorporating more participants, could be carried out in future.

Introduction

Stroke & its Impact

Stroke is a major public health concern, causing death and decreased quality of life in people of all ages (Chen et al., 2014). Ischemic stroke - the most common form, occurs when a blockage reduces blood flow to the brain causing damage to surrounding cells (Musuka, 2015). Haemorrhagic stroke - the next most common, involves blood from an artery bleeding into the brain (Rymer, 2011). The extent of brain injury caused depends on the location in which the blockage took place, total duration of blood starvation and the ability of neighbouring healthy cells to compensate for the damaged ones (Chen et al, 2014).

Psychiatric Symptoms Post Stroke

Meta-analysis suggests that one third of stroke survivors, experience post stroke depression (Hackett et al., 2005) and one quarter develop post stroke anxiety (Schottke & Giabbiconi, 2015), with both disorders gaining research interest and consideration of potential treatment options (Rasquin., et al, 2009 & Broomfield et al., 2011). Sleep associated difficulties are also common post-stroke, with Kim et al (2017) identifying almost two thirds of patients to experience insomnia one-month after stroke. Similarly, Glozier et al (2017) found that 34% of patients, one-year post stroke, met the DSM-5 criteria for insomnia. As well as the distress of the symptom itself, insomnia has been identified as a risk factor for further stroke, suicide, and poorer recovery prognosis (Yang et al., 2017). Despite its high prevalence and impact, treatment for insomnia amongst stroke survivors has had little consideration.

Psychological Treatment for Insomnia

There is a wealth of research supporting the efficacy of talking therapies for insomnia within the general population (Okajima, Komada & Inoue, 2011). Cognitive Behavioural Treatment for Insomnia (CBTI) has been reported to reduce symptoms of insomnia in 70-80% of patients, with long-term improvements documented (Okajima et al., 2011). CBTI has also been found to alleviate insomnia symptoms post intervention and at follow up, in the context of other health conditions including chronic pain (Jungquist et al., 2012), and heart disease (Conley & Redeker., 2015). Similar findings have been found surrounding stroke, with Nguyen et al (2017) carrying out a pilot RCT comprising of 15 participants, nine of which were randomised to a CBTI group and six to a TAU group. CBTI was found to reduce post stroke insomnia immediately after the intervention but not at four months follow up. To the author's knowledge this is the only study that has explored the efficacy of CBTI for post stroke insomnia.

Patients experiencing insomnia alongside a physical health condition may face multiple challenges that impact their ability to attend a traditional 6-8 session CBTI intervention. Troxel, Germain and Buysse (2012) developed a four session, manualised brief behavioural treatment for insomnia (BBTI) which may be more accessible to a wider group of individuals. BBTI is based predominantly on the behavioural components of CBTI principles, as outlined by the National Institute of Health (2005).

This study will aim to deliver BBTI to participants experiencing post stroke insomnia. BBTI will be based on the protocol by Troxel et al., (2012) but tailored to match the needs of the stroke population, e.g. minimising falls risk in the night. Governing bodies state there should be a period of feasibility and pilot testing when developing complex treatment interventions (Medical Research Council, 2000). A feasibility study looking into the effectiveness of BBTI

following brain injury was carried out by Zouharova and Gardani (in preparation). This study, which took the form of a case series design, recruited nine participants and retained six. Four participants experienced “clinically significant sleep improvements”, one showed “treatment response” and one demonstrated “nonresponse”. The proposed study will follow similar research procedures as the feasibility study.

Aims and Hypotheses:

The primary aim of this study is:

a) To explore change in participant sleep efficiency (SE), sleep onset latency (SOL) and sleep duration (SD), before, during and after BBTI, as measured by a series of sleep outcome measures and sleep diaries.
b) To explore the recruitment and retention rate of participants taking part in the study.

The secondary aim of this pilot study is:

a) To determine whether BBTI reduces participant symptoms of anxiety and depression.

CBTI has been found to significantly reduce symptoms of insomnia in the wider population and in the context of physical health problems, including following a stroke. As BBTI includes behavioural components of CBTI, it is hypothesised that outcomes will be similar and participants receiving BBTI will experience a significant reduction in insomnia post intervention.

Additionally, given the recruitment and retention rates reported in the feasibility study by Zouharova and Gardani (in preparation), it is hypothesised that this study will have a high retention rate of participants.

Methods

Participants

The study will recruit approximately 6 participants. Stroke induced disability, as measured by the Modified Rankin Scale (Farrell et al, 1991), will be recorded for each participant, with this information being obtained from patient records or medical provider, after patient consent has been obtained. For participants recruited via the non-NHS route, once patient consent has been sought, the researcher will contact the participant's medical provider to obtain this information.

Inclusion and Exclusion Criteria

Inclusion Criteria:

Eligible participants will have experienced an ischemic or haemorrhagic stroke at least 3 months but fewer than 18 months prior to participating. This is because at least 3 months of sleep disturbance is required for a diagnosis of insomnia. Additionally, insomnia related to a historic stroke may respond differently to BBTI compared to insomnia related to a more recent stroke. Participants should be over 18 years of age and will meet the DSM-5 criteria for insomnia, with levels of insomnia being measured via the Sleep Condition Indicator (SCI; Espie et al, 2014). Participants experiencing other sleep disorders e.g. obstructive sleep apnoea, will be eligible to participate, if the disorder is effectively managed. Participants must exhibit

a good level of cognitive functioning to manage the demands of the study e.g. completing daily sleep diaries and this will be defined as a score of 8 or more out of 10 on the Mini-Montreal Cognitive Assessment (MMOCA; Mai et al 2013) at point of screening.

Exclusion criteria:

Exclusion criteria will include individuals with a diagnosis of dementia, epilepsy, an untreated psychotic illness, substance misuse, other neurological disorders and medications known to impact on sleep. Participants should not have received a previous course of cognitive behavioural therapy for post stroke insomnia. Additionally, people who are aphasic or unable to write will be unable to take part, due to the study requiring written information to be recorded. Individuals experiencing chronic pain, will not be able to take part in the study since chronic pain could interfere with the intervention and results obtained. Potential participants will be asked about current levels of pain and completion of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al, 1989) will inform this. Individuals undergoing rehabilitation will not be eligible to participate in the study since rehabilitation often includes specific CBT for insomnia elements and subsequently could influence overall findings. Finally, participants currently involved in other research will not be eligible to participate.

Recruitment Procedures

Participants will be recruited from a local charity and NHS Stroke Psychology Outpatient Services.

Charity recruitment:

Charity recruitment: Study flyers (Appendix 2.1), offering a brief overview of the study will be displayed within Headway charity premises. The flyer will advise service users to contact a Headway staff member if they are interested in participating who will then provide them with a participant information sheet (Appendix 2.2). If the service user wishes to participate or receive more information about the study, they can contact the researcher by telephone, sending 'the note of interest' slip attached to the information sheet or by asking a Headway staff member to make contact on their behalf. The researcher will then arrange to meet with the individual, either on charity premises or at the individual's home to discuss the study further.

NHS Recruitment: The researcher will present details of the study to NHS Stroke Psychology Outpatient Services. Staff will hand out participant information sheets to patients with symptoms of insomnia and who may be eligible to participate. Interested patients can contact the researcher in the same way as described for Headway service users. Once contact has been made, the researcher will arrange to meet the patient, either at Headway or in the patient's own home, to discuss the study further.

Consent and Measures

At the initial meeting, discussion will take place on what participation involves, assessing individual suitability using the inclusion/exclusion criteria and answering queries throughout. If the individual wishes to proceed and they meet the criteria, written consent will be obtained (Appendix, 2.3). Consenting participants will complete several outcome measures including: the Pittsburgh Sleep Quality Index (PSQI, Buysse et al., 1989), the Sleep Condition Indicator

(SCI, Espie et al., 2014), the Mini-Montreal Cognitive Assessment (MMOCA, Mai et al., 2013), the semi-structured sleep questionnaire (Gardani, et al., 2015), the Generalised Anxiety Disorder (GAD-7, Spitzer et al., 2006) and the Patient Health Questionnaire (PHQ-9, Kroenke & Spitzer., 2001). Further information on measures used can be found in Appendix 2.4.

Additionally, participant demographic information will be collected in the first meeting with participant co-morbid conditions documented. Self-reports will be verified via patient records or by the participant's medical provider, following consent.

Finally, participants will be provided with sleep diaries (Appendix 2.5) for completion throughout the duration of the study with demonstrations on their completion taking place. Sleep diaries will collate information on participant sleep onset latency, sleep efficiency and wake after sleep onset. Participants will then be randomised to a baseline phase. The first day of the baseline phase will not commence until 24 hours after the initial meeting. Participants can choose to withdraw within these 24 hours or at any point of the study.

Design & Research Procedures

This study will take the form of a single case experimental design (SCED), aiming to recruit 6 participants. At the end of the initial meeting, participants will be randomly allocated, using a random number generator (www.randomizer.org), to differing baseline durations (ranging 5 to 20 days). Following the baseline phase, participants will then commence the intervention stage before finally returning to a post intervention, 7-day baseline phase. The intervention will be delivered across 4, weekly sessions. The first session will last approximately 1 hour and will take place at Headway or in the patient's own home. The remaining 3 sessions will last approximately 20 minutes and be delivered over telephone. One more face to face session will

take place after the final baseline phase, to return sleep diaries and complete post intervention outcome measures. For an overview of the BBTI see Appendix 2.6.

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Data Analysis

Visual analysis of the data will be carried out, graphing the data collected and visually inspecting any differences between baseline and intervention phases. Historically, it was suggested that in SCED designs, visual inspection of the data demonstrated results that statistical tests failed to find (Bobrovitz & Ottenbacher., 1998). It has been acknowledged, however, that visual analysis alone provides some difficulties e.g. collating results for meta-analysis and allowing for comparison (Tate et al., 2015). Although there is no consensus on which statistical procedure to use in analysing SCED data (Bobrovitz & Ottenbacher., 1998), the methods available tend to follow the same principle whereby they measure the extent of non-overlapping data between differing conditions. Tau-U analyses is one statistical method that controls for baseline trend and has an effect size index that is reported as being suitable in single case research data where parametric assumptions are often not met (Tate et al., 2015). It is unlikely that due to the small sample, parametric assumptions would be met in this study and thus this is the most likely statistical test of choice. Similarly, as data are unlikely to be normally distributed the non-parametric Wilcoxon signed-rank test will be used to compare participant scores on outcome measures pre and post the intervention. Data on recruitment and retention rates will also be reported as will data from the Participant Treatment and Acceptability Questionnaire.

Updated & Expanded Data Analysis

Data will be presented graphically for visual analysis across and within phases, using the SCDA plug in for R Commander (Bulte & Onghena, 2008). Each participant will have a total of 3 graphs, with the first focusing on 'sleep efficiency', measured as a percentage, the second will illustrate 'sleep onset latency', measured in minutes and lastly, the third graph will display 'sleep duration', also measured in minutes. On all 3 graphs, 'number of days' will be on the horizontal axis. Additionally, the point in which the intervention started and ended will be illustrated on the graph by vertical lines. The following parameters will be considered when visually interpreting each graph: central location, trend, and variability (Morley, 2018). Central location involves calculating either the mean (or median values - if not normally distributed) of the baseline and intervention phases and then drawing a horizontal line on the graph to illustrate where the mean lies. Differences in mean values will then be calculated. A trend refers to the pattern of data points. Nugent (2001) suggests drawing a straight line from the first and last data points in both the baseline and intervention phases with these lines then being visually inspected for trends. If visual inspection indicates the presence of data trends, then Kendall's Tau-b analyses will be carried out to determine whether these trends are significant. Finally, variation of data will be inspected. The greater the variation the less likely significant trends will be found, and overall conclusions made about the efficacy of the BBTI. Range lines will be included in the graph to illustrate variability.

Partially following the parameters set out in the feasibility study by Zouharova and Gardani (in preparation), significant change would be indicated if two of the following were met: (1) PSQI score of <8, (2) SCI score of ≥ 24 and (3) Sleep Effiency$\geq 85\%$ (4) Sleep Onset Latency<20mins and (5) Sleep Duration ≥ 7 hours. Numbers (4) and (5) were not included in the feasibility study

and subsequently these parameter guidelines were taken from Zhu et al (2019). Inter-rater agreement will be sought regarding visual inspection.

A large table illustrating sleep diary data for baseline and intervention phases, for all 6 participants, will be included in the results section. A table comprising of pre and post intervention scores for SCI, PSQI, GAD-7, PHQ-9 will be included also.

Justification of sample size

Other than the feasibility study currently under review by Zouharova and Gardani (under preparation), which employed a case series design, no other study to the author's knowledge has been carried out in this area. Krasny-Pacini and Evans (2018) suggest SCED designs typically involve a 'small number of participants, usually one to three. Dallery, Cassidy and Raiff (2013) state that the number of participants in a SCED study is 'always more than 1, usually around 6 but sometimes as many as 20'. As there is no clear guidance on participant numbers in the literature, based on the numbers by Zouharova and Gardani (under preparation), this study will aim to recruit 6 participants.

Settings and Equipment

The intervention will take place either in charity premises or at the participant's own home. Participants will receive BBTI specific workbooks and will complete several standardised outcome measures pre and post intervention.

Researcher Safety Issues

Due to the potential incorporation of home visits into the study, the researcher will follow local NHS lone working policy guidelines (GG&C Lone working policy, 2014). It states that the researcher must advise another staff member of their whereabouts, devising a 'clock in and clock out' system whereby their location is always accounted for.

Critical Appraisal of Planned Methods

Inclusion/Exclusion Criteria

BBTI, which was tailored to meet the needs of the stroke population, may have greater validity if only participants experiencing their first episode of insomnia were recruited to the study - excluding those with a history of insomnia prior to stroke. Post stroke insomnia and non-stroke related insomnia could respond differently to BBTI however as the inclusion/exclusion criteria stands, this would not have been controlled for. Furthermore, asking participants if they had changed or taken any new sleep medication throughout the intervention would have been beneficial. Ethically, it would not be appropriate to ask a participant to withhold new medication during BBTI however having this information would be helpful when making overall conclusions about the efficacy of the BBTI intervention. Additionally, excluding all aphasic individuals may have been unfair and unnecessary. If individuals who were aphasic wished to participate and were able to communicate their sleep experiences reliably, then potentially another individual could complete daily sleep diaries on the participant's behalf. Given that around a third of people who have a stroke experience aphasia (Flowers et al., 2016), excluding these individuals means that the efficacy of BBTI for post stroke insomnia would not be validated on a representative sample of the stroke community.

Design

Morley (2018) states that ‘measurements in the baseline are taken until a pattern emerges’ and ‘at least 3 measurements are required to constitute a pattern’. The smallest baseline phase in this study was 5 days, which may have been too short to observe a sleep pattern in all cases and subsequently draw reliable pre and post intervention conclusions. An alternative might have been to provisionally set baseline phases but with the understanding that baselines may need to be increased if a stable pattern had not emerged in this time frame. Additionally, the large number of outcome measures for completion pre and post intervention, may have been overwhelming and off putting for participants. As the SCI and PSQI are both validated measures and essentially measure the same sleep characteristics, it may have been sufficient to include only one of these. As the PSQI specifically asks a question on pain levels, I would have favoured this measure over the SCI since pain is considered in the inclusion/exclusion criteria.

Ethical Issues

Permission will be sought from NHS ethics boards. Information and consent forms will be given to participants outlining the aims of the study (BPS, 2010). Confidentiality will be maintained by storing participant personal information securely in a locked case within a locked filing cabinet at NHS premises or on a password protected/encrypted file on an NHS computer (Data Protection Act, 2018). Personal data will be removed from research data and stored in a password protected Excel spreadsheet on a password protected NHS computer. Data will be stored securely for ten years following completion of the study in line with university and EU/UK guidelines (Medical Research Council, 2000).

Participants will be reminded throughout the information and consent processes and during the intervention that participation is entirely voluntary, they are free to stop or take a break at any point, without any impact on their overall care.

Practical Applications

Given the high prevalence of insomnia within this population, if successful, BBTI could potentially help many individuals achieve better sleep. Additionally, as insomnia is a risk factor for other conditions e.g. future stroke, positive outcomes from the BBTI may help participants maintain better health in future.

If the BBTI is found to reduce participants' symptoms of insomnia, a larger study could be rolled out incorporating higher participant numbers.

Dissemination

The results of the study will be written in the trainee clinical psychologist's thesis and distributed to NHS Stroke Psychology Outpatient Services and to Headway charity. Additionally, outcomes will be disseminated via DClinPsy doctorial theses, publications in peer-reviewed journals and national conference proceedings.

Timetable

Task	Estimated Time to Complete	Estimated Start Date	Estimated Completion Date
MRP Draft	4 months	September 2017	January 2018
MRP proposal	6 months	January 2018	June 2018
Finalise Proposal and Materials	18 months	June 2018	January 2020
Ethics Submission	1 month	February 2020	February 2020
Recruit and gather data	3 months	March 2020	May 2020
Data Analysis	2 weeks	May 2020	May 2020
Final write up	2 months	June 2020	July 2020

References

Bobrovitz, C. D., & Ottenbacher, K. J. (1998). Comparison ofvisual inspection and statistical analysis of single-subject datain rehabilitation research. American Journal of PhysicalMedicine & Rehabilitation, 77, 94–102.

Broomfield, N. M., Laidlaw, K., Hickabottom, E., Murray, M. F., Pendrey, R., Whittick, J. E., & Gillespie, D. C. (2011). Post stroke depression: The case for augmented, individually tailored cognitive behavioural therapy. *Clinical Psychology & Psychotherapy, 18*(3), 202-217.

Bulté, I., & Onghena, P. (2008). An R package for single-case randomization tests. *Behavior Research Methods*, *40*(2), 467-478.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research 28:193-213.*

Chen, J., Hu, X., Stenzel-Poore, M., & Zhang, J. H. (Eds.). (2014). *Immunological mechanisms and therapies in brain injuries and stroke*. Springer New York.

Conley, S., & Redeker, N. S. (2015). Cognitive behavioral therapy for insomnia in the context of cardiovascular conditions. *Current Sleep Medicine Reports, 1*(3), 157-165.

Dallery, J., Cassidy, R. N., & Raiff, B. R. (2013). Single-Case Experimental Designs to Evaluate Novel Technology-Based Health Interventions. *Journal of Medical Internet Research, 15*(2).

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ Open, 4(3), e004183.*

Farrell B, Godwin J, Richards S, Warlow C, et al. (1991). The United Kingdom transient ischaemic attack (UK-TIA) aspirin trial: final results. J Neurol Neurosurg Psychiatry, 54 (12): 1044–1054.

Flowers, H. L., Skoretz, S. A., Silver, F. L., Rochon, E., Fang, J., Flamand-Roze, C., & Martino, R. (2016). Poststroke aphasia frequency, recovery, and outcomes: a systematic review and meta-analysis. *Archives of physical medicine and rehabilitation*, *97*(12), 2188-2201.

Glozier, N., Moullaali, T., Sivertsen, B., Kim, D., Mead, G., Jan, S., . . . Hackett, M. (2017). The course and impact of poststroke insomnia in stroke survivors aged 18 to 65 years: Results from the psychosocial outcomes in StrokE (POISE) study. *Cerebrovascular Diseases Extra, 7*(1), 9-20

Hackett, M., Yapa, C., Parag, V., & Anderson, C. (2005). Frequency of depression after stroke - A systematic review of observational studies. *Stroke, 36*(6), 1330-1340.

Jungquist, C. R., Tra, Y., Smith, M. T., Pigeon, W. R., Matteson-Rusby, S., Xia, Y., & Perlis, M. L. (2012). The durability of cognitive behavioral therapy for insomnia in patients with chronic pain. *Sleep Disorders, 2012*, 1-8.

Kim, W., Jung, H., Choi, H., Park, C., Kim, E., Lee, S., . . . Joa, K. (2017). The associations between insomnia and health-related quality of life in rehabilitation units at 1 month after stroke. *Journal of Psychosomatic Research, 96*, 10-14.

Krasny-Pacini, A. and Evans, J. (2018) Single-case experimental designs (SCEDs) to assess intervention effectiveness in rehabilitation: a practical guide. *Annals of Physical and Rehabilitation Medicine*, (doi:10.1016/j.rehab.2017.12.002).

Kroenke, K.,& Spitzer, R.L. *(2001).* The PHQ-9*:* validity of a brief depression severity measure. *J Gen Intern Med, (*16,*),* 606–13.

Mai, L. M., Oczkowski, W., Mackenzie, G., Shuster, A., Wasielesky, L., Franchetto, A et al. (2013) Screening for cognitive impairment in a stroke prevention clinic using the MoCA. *The Canadian Journal of Neurological Sciences, 40(2): 192–197.*

Medical Research Council. (2000). *A framework for the development and evaluation of RCTs for complex interventions to improve health*. London: MRC,

Morley, S. (2018). Single Case Methods in Clinical Psychology. London: Routledge, https://doi.org/10.4324/9781315412931

Musuka, T. D., Wilton, S. B., Traboulsi, M., & Hill, M. D. (2015). Diagnosis and management of acute ischemic stroke: speed is critical. *Cmaj*, *187*(12), 887-893.

Nasreddine, S., Phillips, N. A., Bédirian, V, *et al.* (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc* **53**: 695–699.

National Institutes of Health. National Institutes of Health State of the Science Conference statement on manifestations and management of chronic insomnia in adults. (2005). *Sleep, 28*(9):1049–57.

Nguyen, S., Wong, D., McKay, A., Rajaratnam, S., Spitz, G., Williams, G., Mansfield, D., & Ponsford, J. L. (2019). Cognitive behavioural therapy for post-stroke fatigue and sleep disturbance: a pilot randomised controlled trial with blind assessment. *Neuropsychological Rehabilitation, 29*:5, 723-738.

Nugent, W. R. (2001). Single case design visual analysis procedures for use in practice evaluation. *Journal of Social Service Research*, *27*(2), 39-75.

Okajima, I., Komada, Y., & Inoue, Y. (2011). A meta-analysis on the treatment effectiveness of cognitive behavioral therapy for primary insomnia. *Sleep and Biological Rhythms, 9*(1), 24-34

Rasquin, S. M. C., Van De Sande, P., Praamstra, A. J., & Van Heugten, C. M. (2009). Cognitive-behavioural intervention for depression after stroke: Five single case studies on effects and feasibility. *Neuropsychological Rehabilitation, 19*(2), 208-222.

Rymer, M. M. (2011). Hemorrhagic stroke: intracerebral hemorrhage. *Missouri medicine, 108*(1), 50.

Schottke, H., & Giabbiconi, C. (2015). Post-stroke depression and post-stroke anxiety: Prevalence and predictors. *International Psychogeriatrics, 27*(11), 1805-1812.

Spitzer, R. L., Kroenke. K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch Intern Med.*166(10):1092–1097.

Tate, R. L., Perdices, M., Rosenkoetter, U., Wakim, D., Godbee, K., Togher, L., et al. (2013). Revision of a method quality rating scale for single-case experimental designs and n-of-1 trials: the 15-item Risk of Bias in N-of-1 Trials (RoBiNT) Scale. *Neuropsychol Rehabil* ;23: 619–38.

Troxel, W. M., Germain, A.,&Buysse, D. J. (2012). Clinical management of insomnia with brief behavioral treatment (BBTI). *Behav Sleep Med, 10: 266–79.*

Yang, Y., Shi, Y., Zhang, N., Wang, S., Ungvari, G., Ng, C., . . . Xiang, Y. (2017). Suicidal ideation at 1-year post-stroke: A nationwide survey in china. *General Hospital Psychiatry*, *44*, 38-42.

Chapter 3: Brief Report

Is the Relationship between Loneliness and Insomnia, mediated by Depression and Anxiety in a Student Sample?

Chapter word count: 3412

Prepared in accordance with the guidelines for submission to SLEEP journal (Appendix 1.1)

Plain English Summary

Introduction: Loneliness and symptoms of insomnia are higher in undergraduate students compared to the general population (Beutel et al., 2017). There may be a number of reasons for this including leaving home for the first time and a change in sleep routine (Taylor et al., 2013). There has been some research to suggest that insomnia and loneliness are linked and that as one difficulty increases/decreases then so does the other. Additionally, it has been suggested that the link between insomnia and loneliness may only exist when symptoms of anxiety and depression are also present (Choueiry et al., 2016).

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Aim of the Study: 1) To explore the frequency of loneliness, insomnia, anxiety, and depression in undergraduate students 2) To determine if insomnia and loneliness are connected and if the severity of one changes with the severity of the other 3) To explore whether symptoms of anxiety and or depression effect the connection between insomnia and loneliness.

Research Questions to be addressed: Is loneliness connected with insomnia in undergraduate students and if so, do symptoms of anxiety and depression explain this connection.

Methods

Participants: 1117 undergraduate students across 6 UK universities took part in the study.

Recruitment: Undergraduates were invited to take part in the study through University emails and through advertisements on social media.

Design: Undergraduates completed an online questionnaire exploring the frequency of mental health problems.

Key ethical issues: Completion of the questionnaire may have brought up some difficult feelings for participants. Advice on what to do in this situation was provided at the beginning and end of the questionnaire e.g. speak with your GP if you feel your symptoms are causing you difficulty, as well as contact numbers for the Samaritans and Breathing Space.

Impact: Understanding the link between loneliness and insomnia and also whether anxiety or depression influences this connection, may help determine ways to manage these symptoms in future.

References:

Beutel, M. E., Klein, E. M., Brähler, E., Reiner, I., Jünger, C., Michal, M., ... & Tibubos, A. N. (2017). Loneliness in the general population: prevalence, determinants and relations to mental health. *BMC psychiatry*, *17*(1), 1-7.

Choueiry, N., Salamoun, T., Jabbour, H., El Osta, N., Hajj, A., & Rabbaa Khabbaz, L. (2016). Insomnia and Relationship with Anxiety in University Students: A Cross-Sectional Designed Study. *PloS one*, *11*(2), e0149643. https://doi.org/10.1371/journal.pone.0149643

Taylor, D. J., Bramoweth, A. D., Grieser, E. A., Tatum, J. I., & Roane, B. M. (2013). Epidemiology of insomnia in college students: relationship with mental health, quality of life, and substance use difficulties. *Behavior therapy*, *44*(3), 339-348.

Abstract

Background: Previous research has found an association between loneliness and insomnia however it is unclear if this link exists within a student population and if so, whether it is mediated by feelings of anxiety and depression. This study explores this further.

Methods: Secondary data was analysed on 1117 undergraduate students, across 6 UK Universities, who had completed self-report measures of insomnia, loneliness, anxiety, and depression

Results: A moderate association ($r=-.388$, $p<.001$) was found between loneliness and insomnia. Multiple regression indicated that depression fully mediated the relationship between loneliness and insomnia, whilst there was no mediating effect of anxiety.

Conclusion: Students with symptoms of insomnia and loneliness are likely to experience symptoms of depression although not necessarily anxiety. Although loneliness is not classed as a psychiatric disorder, treating symptoms of depression may benefit those with complaints of loneliness and insomnia since a reduction in depression may indirectly reduce these symptoms too.

Introduction

Symptoms of insomnia within the student population are estimated to range between 8% and 69%, depending on the insomnia criteria used (Taylor et al., 2013). Poor sleep, frequent awakenings and low total sleep time are common sleep complaints reported by students (Bulbotz et al., 2001). Multiple factors may account for a higher prevalence of insomnia within this population, including academic pressure, a change in bedtime routine and easy access to drugs and alcohol (Taylor., 2013).

Undergraduates report loneliness and this can be associated with having few established social connections whilst transitioning to University, often in the context of leaving home for the first time (Hom et al, 2017). Diehl et al (2018) found that 32% of undergraduates experienced loneliness, compared to 10% found within the general population (Beutel et al, 2017).

Although limited, recent evidence suggests that insomnia (Hom et al., 2017), lower sleep efficiency (Cacioppo et al., 2002), poorer sleep quality (Harris et al., 2013) and increased sleep fragmentation (Kurina et al., 2011) are associated with loneliness. Cacioppo & Cacioppo (2014) hypothesise that this link may be due to the evolutionary fight or flight response and that loneliness signifies a social disconnect and an unsafe environment, leading to hypervigilance for social threats.

Symptoms of insomnia significantly correlate with other psychiatric disorders common within the student population including anxiety (Choueiry et al., 2016) and depression (Akram et al., 2019). The relationship between loneliness and insomnia has been found to be mediated by anxiety (Zawadzki, Graham & Gerin, 2012), and by depression but not anxiety (Hom et al., 2017). Therefore, although there is evidence for an association between loneliness and insomnia, the mediating role of anxiety and depression is unclear. The present study explores this further.

Research Questions

1) Is loneliness associated with insomnia in undergraduate students?
2) Does anxiety and/or depression mediate any relationship between loneliness and insomnia?

2. Methods

2.1 Sample and Procedure

Data from an earlier study was used (Akram et al (2020a, b, c) with Dr Gardani a supervisor of this project and a co-author of the previous study, granting access to the dataset (Appendix 3.1). This study explored the prevalence of mental health difficulties in students and was approved by Sheffield Hallam University Research Ethics Committee (Reference Number: ER7368595). Undergraduate students across 6 UK universities were recruited via institutional course participation schemes and social media pages. A course credit was provided to students on request at completion if they were eligible. Participants completed an online questionnaire, designed to measure the prevalence of psychiatric symptoms including depression, loneliness, anxiety, and insomnia and although not analysed in this report, questions also on mania, psychosis, perfectionism, and suicidal ideation. After removing incomplete responses (377), data from 1117 individuals were included in the final analysis.

2.2 Measures

Loneliness was assessed using the UCLA Loneliness Scale (Russell, 1996). The UCLALS has 20-items that assess how often an individual feels disconnected from others. Items are scored using a 4-point scale (1=never - 4=always). Scores on the UCLALS range from 20-80, with

higher scores indicating greater loneliness. The UCLALS is not a clinical tool and no clinical 'cut-offs' have been developed.

Symptoms of depression were measured using the Patient Health Questionnaire: (PHQ-9; Lowe et al., 2004), a nine-item measure assessing key symptoms of depression as outlined in the DSM-5. Items are scored on a 4-point scale. The maximum score on the PHQ-9 is 27, with higher scores indicating greater severity of depression. A score of 10 or more indicates possible depression.

Anxiety was measured using the Generalised Anxiety Disorder-7: (GAD-7; Shear et al., 2006). Seven items are scored on a 4-point Likert type scale (0=not at all - 3=nearly all days), providing a total score ranging from 0-28. Higher scores indicate higher levels of anxiety, with scores ≥11 indicating possible cases of generalised anxiety disorder.

Symptoms of insomnia were assessed using the Sleep Condition Indicator (SCI; Espie et al., 2014), an eight-item questionnaire with items scored on a 5-point scale; total scores range from 0-32, and higher scores indicate better sleep.

2.3 Statistical Analysis

All analyses were carried out using IBM SPSS, Version 24.0 (IBM Corp, Armonk, N.Y., USA). Missing data and outliers were checked for via frequency tables and boxplots. A data point was defined as an outlier if it was more than 1.5 interquartile ranges below the first quartile or above the third quartile and located out with the whiskers of the boxplot. All data were present, and no outliers were identified.

A Shapiro-Wilk's test (Shapiro & Wilk, 1965) and a visual inspection of histograms and boxplots showed that scores for loneliness were normally distributed, and scores for anxiety, depression and insomnia were not normally distributed ($p<.05$).

As not all data were normally distributed, Spearman's correlations were carried out between insomnia symptoms, loneliness as well as anxiety and depression.

A linear regression was performed, with loneliness as the independent variable and insomnia as the dependent variable to determine if loneliness predicted insomnia. A multiple regression was then performed, comprising of loneliness and both mediators (anxiety and depression) as independent variables to determine whether they significantly predicted insomnia. Regression indicated that the four conditions of mediation set out by Baron & Kenny (1986) were met (Appendix 3.1), allowing the strength of mediation to be calculated using PROCESS macro Version 3 (Hayes, 2012). Significance was set at the $p<0.05$ level (two-tailed).

2.4 Results

Of the 1117 undergraduates in the analysis, 83% were female. The mean age was 20, with an age range of 18–56 years. Overall, 43% scored below ≤16 on the SCI, indicating 'probable insomnia' whilst 46% and 43% scored in the 'moderate to severe' range for depression and anxiety, respectively. Mean score on the UCLALD was 44.7 (Table 1).

Table 1. Median (IQR) and Mean (SD) of scores for outcome measures

Outcome measure (clinical cut off scores)	*Median or Mean* Score*	*Proportion scoring above clinical 'cut-off'; % and (N)*	*Interquartile Range (range)*

PHQ–9 (≥10)	9	46% (509)	4-15 (0-27)
GAD–7 (≥10)	8	43% (478)	4-14 (0-21)
SCI (≤16)	18	43% (478)	12-24 (0-32)
UCLALD	44.7* (12.3)	N/A	35-54 (20-76)

Insomnia was significantly correlated with loneliness (r=-.381, p<.001), anxiety (r=-.519, p<.001) and depression (r=-.635, p<.001). Significant associations were also found for loneliness with anxiety (r=.573, p<.001), and depression (r=.650, p<.001) and between anxiety and depression (r=.784, p<.001).

Linear Regression

A linear regression with loneliness as the predictor and insomnia as the outcome variable was significant, β=-0.376, SE=.016, p<.001 (one of four requirements of mediation, Baron & Kenny, 1986).

Multiple Regression

Self-report of insomnia was the dependent variable and ratings for loneliness, anxiety and depression were independent variables. Preliminary analysis indicated that assumptions regarding linearity, multicollinearity and normality were met. The model for insomnia was significant (R^2=.39); scores on the SCI were predicted by depression (Beta=-.618, p=.001) but not loneliness (Beta=-.064, p=.066) or anxiety (Beta=.065, p=.082), (see Table 2).

Table 2: Regression model of predictors of insomnia, with confidence intervals reported in brackets.

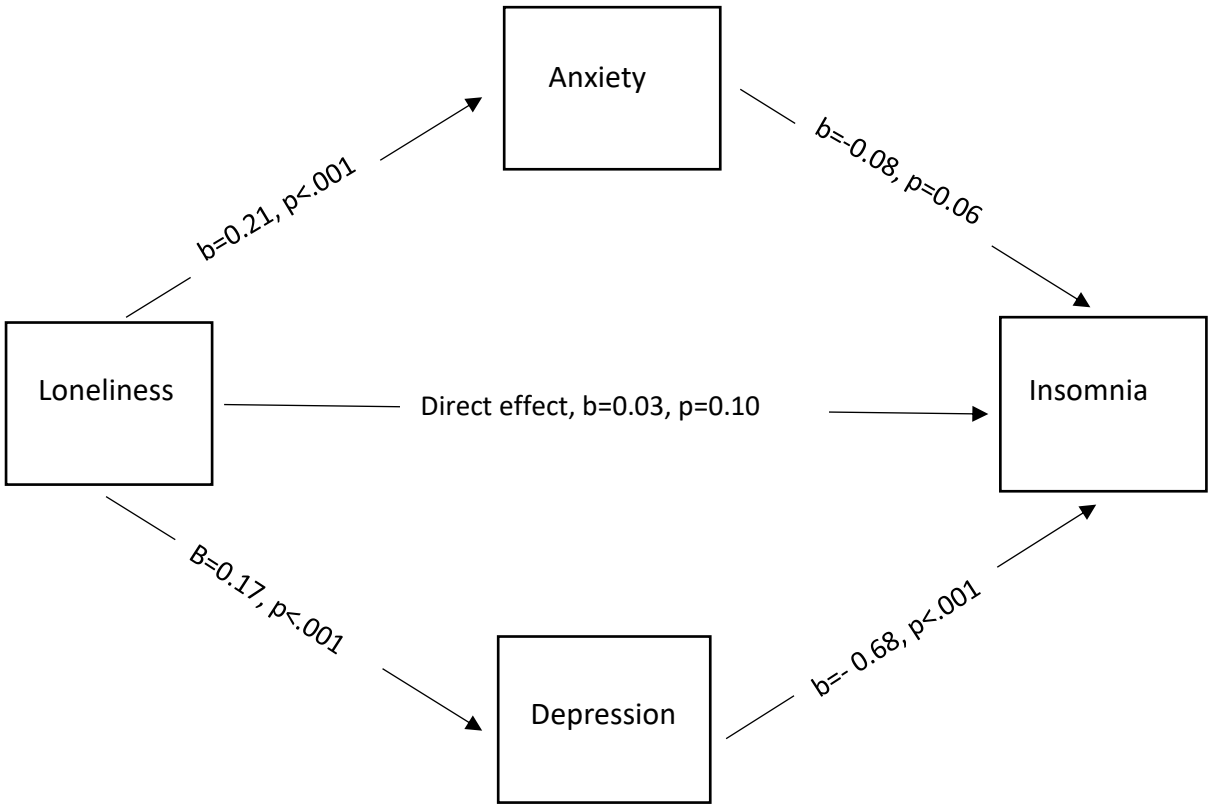
	B (95% CI)	*SE B*	*Beta*	*p value*
Constant	*29.448* *(25.42, 32.22)*	*1.151*		*.001*
Loneliness	*-.038* *(-.006, .065)*	*.018*	*-.064*	*.066*
Anxiety	*-.078* *(-.172, .005)*	*.045*	*-.065*	*.082*
Depression	*-.674* *(-.766, -.591)*	*.044*	*-.618*	*.001*

R^2 = .39

Mediation analysis

Mediation analysis indicated a significant indirect effect of loneliness on insomnia via depression and no significant indirect effect of anxiety was found (Figure 1).

Figure 1: *Model of loneliness as a predictor of insomnia, potentially mediated by anxiety and depression. Regression co-efficients and significance levels are provided.*



Indirect total effect (through both anxiety and depression), b=-0.27, 95% CI [-0.30, -0.24]
Indirect total effect (through anxiety), b=-0.02, 95% CI [-0.05, 0.00]
Indirect total effect (through depression), b=-0.24, 95% CI [-0.28, -0.21]

Discussion

This study found a significant association between loneliness and insomnia in undergraduates with a large effect. When depression was added to the model, the direct effect of loneliness on insomnia was no longer significant, suggesting that the relationship between loneliness and insomnia is best understood through depression. Females scored significantly higher on measures of insomnia, anxiety, and depression but no significant differences were found for loneliness. No significant mediating effect of anxiety was identified.

Just under half (43%) of students scored in the 'probable' range for insomnia, in the middle of the range (9-69%) reported by Taylor et al (2003). The prevalence of depression (46%) was higher than previous findings in students e.g. 33-35% (Beiter et al 2015; Jenkins et al 2020), whilst complaints of anxiety (43%) were similar to previous findings (Taylor et al., 2003; Beiter et al 2015). There was a high proportion of females in this study and this could account for the high rates of depression found. Females in the general population tend to self-report higher rates of depression (Bramness et al, 2010). Furthermore, there is a possible selection bias, whereby the study may have been more attractive to individuals experiencing sleep problems which is also a symptom of depression (Zimmerman et al., 2015). Lastly, this study included a large sample and recruited students from differing faculties, across multiple Universities. The inclusion of a potentially more diverse range of participants in this study could explain why results are out with the previously reported trend.

Hom et al (2017) reported findings that are similar to those in the present study (a relationship between loneliness and insomnia that was mediated by depression and not anxiety).

On the other hand, Cacioppo et al (2002) found loneliness predicted insomnia in a population of students, even when depression was controlled for. The sample size was small (N=37) and two-thirds (24) were male. Participation in this study was dependent on individuals scoring in

the ‘non-clinical’ range of the Beck Depression Inventory (BDI), a self-report measure. As males have been found to under report symptoms of depression on self-report measures (Sigmon et al., 2005), it is possible that depression was under-reported in the study by Cacioppo et al (2012) given the high proportion of males. If so, depression may not have been controlled for as intended.

In relation to loneliness, a growing body of research indicates that social networks and connections significantly impact mental wellbeing (Jetten, Haslam & Haslam, 2012) and subsequently evidence-based treatment options to reduce perceived loneliness have been developed (Cacioppo et al, 2015). These include programs that a) increase social skills b) increase social contacts and c) address maladaptive social cognitions e.g. Cognitive Behavioural Therapy which the meta-analysis by Masi et al (2011) found to be most effective of all. Although to the author’s knowledge no studies exploring the efficacy of interventions targeted at loneliness have taken place specifically in the undergraduate student population, the positive findings within the general adult population are encouraging and possibly generalizable to students, since there is a crossover of age between these two groups (Masi et al, 2011). Additionally, the high association of loneliness with anxiety and depression in this study suggest that it may share similar constructs to these variables and subsequently treating these disorders could indirectly reduce perceived loneliness also.

Study Limitations & Future Research

Inconsistencies between self-report measures and objective measures of sleep e.g. polysomnography have been identified (Morin, Cuthbert & Schwartz, 1994). As this study utilised subjective measures only, there is room for more comprehensive assessment of insomnia in future. Discrepancies in modes of measurement mean that insomnia severity could have been under or over-estimated, which could affect the validity of overall findings.

The significant mediating effect of depression on loneliness and insomnia is perhaps unsurprising given that insomnia is a symptom of depression. One way to explore and potentially minimise this immediate 'head start' in mediation would be to complete mediation analysis incorporating all of the questions on the PHQ-9 measure in the first instance before going on to complete a second mediation analysis but this time removing the outcomes of the sleep related question on the PHQ-9 measure. This would offer insight as to whether depression mediates the loneliness and insomnia relationship solely because of its shared constructs with sleep or whether its mediating effects are present beyond this.

There was an over-representation of females in this study and gender differences in the regression and mediation models were neither explored nor controlled for as this was out with the scope of the report. Subsequently results obtained may not be representative of the wider population. Similarly, age was not explored or controlled for during data analysis. Although 95% of the sample in this study were aged between 18 - 25 years, mature students were not excluded and could have influenced overall results obtained. Future studies should aspire to explore gender and age differences and whether they impacted outcomes. Finally, longitudinal studies that include time frames pre and post University, e.g. at school and post University employment, may capture causality and identify predictor and moderating variables. Longitudinal studies exploring these variables have been carried out in differing populations e.g. Santini et al (2020) found loneliness and social isolation predicted anxiety and depression in a sample of older adults however due to population trait differences these findings may not be generalizable to undergraduate students.

Conclusion

Loneliness was associated with insomnia in University undergraduates however this relationship was driven solely by symptoms of depression. This effect may be associated with gender, with a high proportion of females included in the study and with females reporting more depression, as was the case in this study. The results found suggest that a direct relationship between loneliness and insomnia may not exist but instead is best understood through their mutual association with depression.

References

Akram, U., Gardani, M., Irvine, K., Allen, S., Ypsilanti, A., Lazuras, L., ... & Akram, A. (2020a). Emotion dysregulation mediates the relationship between nightmares and psychotic experiences: results from a student population. *npj Schizophrenia*, *6*(1), 1-7.

Akram, U., Gardani, M., Riemann, D., Akram, A., Allen, S. F., Lazuras, L., & Johann, A. F. (2020b). Dysfunctional sleep-related cognition and anxiety mediate the relationship between multidimensional perfectionism and insomnia symptoms. *Cognitive processing*, *21*(1), 141-148.

Akram, U., Ypsilanti, A., Gardani, M., Irvine, K., Allen, S., Akram, A., ... & Matuszyk, E. (2020c). Prevalence and psychiatric correlates of suicidal ideation in UK university students. *Journal of affective disorders*, *272*, 191-197.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182

Beard, C., & Björgvinsson, T. (2014). Beyond generalized anxiety disorder: psychometric properties of the GAD-7 in a heterogeneous psychiatric sample. *Journal of anxiety disorders*, *28*(6), 547-552.

Beutel, M. E., Klein, E. M., Brähler, E., Reiner, I., Jünger, C., Michal, M., ... & Tibubos, A. N. (2017). Loneliness in the general population: prevalence, determinants and relations to mental health. *BMC psychiatry*, *17*(1), 1-7.

Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., & Sammut, S. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *Journal of affective disorders*, *173*, 90-96.

Buboltz Jr, W. C., Brown, F., & Soper, B. (2001). Sleep habits and patterns of college students: a preliminary study. *Journal of American college health*, *50*(3), 131-135.

Cacioppo, J. T., & Cacioppo, S. (2014). Social relationships and health: The toxic effects of perceived social isolation. *Social and personality psychology compass*, *8*(2), 58-72.

Cacioppo, S., Grippo, A. J., London, S., Goossens, L., & Cacioppo, J. T. (2015). Loneliness: Clinical import and interventions. *Perspectives on Psychological Science*, *10*(2), 238-249.

Cacioppo, J. T., Hawkley, L. C., Berntson, G. G., Ernst, J. M., Gibbs, A. C., Stickgold, R., & Hobson, J. A. (2002). Do lonely days invade the nights? Potential social modulation of sleep efficiency. *Psychological Science*, *13*(4), 384-387.

Choueiry, N., Salamoun, T., Jabbour, H., El Osta, N., Hajj, A., & Rabbaa Khabbaz, L. (2016). Insomnia and Relationship with Anxiety in University Students: A Cross-Sectional Designed Study. *PloS one*, *11*(2), e0149643. https://doi.org/10.1371/journal.pone.0149643

Diehl, K., Jansen, C., Ishchanova, K., & Hilger-Kolb, J. (2018). Loneliness at universities: determinants of emotional and social loneliness among students. *International journal of environmental research and public health*, *15*(9), 1865.

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ open*, *4*(3), e004183.

Espie, C. A., Farias Machado, P., Carl, J. R., Kyle, S. D., Cape, J., Siriwardena, A. N., & Luik, A. I. (2018). The Sleep Condition Indicator: reference values derived from a sample of 200 000 adults. *Journal of sleep research*, *27*(3), e12643.

Griffin, S. C., Williams, A. B., Ravyts, S. G., Mladen, S. N., & Rybarczyk, B. D. (2020). Loneliness and sleep: A systematic review and meta-analysis. *Health Psychology Open*, *7*(1), 2055102920913235.

Harris, R. A., Qualter, P., & Robinson, S. J. (2013). Loneliness trajectories from middle childhood to pre-adolescence: Impact on perceived health and sleep disturbance. *Journal of Adolescence*, *36*(6), 1295-1304.

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling.

Heinrich, L. M., & Gullone, E. (2006). The clinical significance of loneliness: A literature review. *Clinical psychology review*, *26*(6), 695-718.

Hom, M. A., Hames, J. L., Bodell, L. P., Buchman-Schmitt, J. M., Chu, C., Rogers, M. L., ... & Winer, E. S. (2017). Investigating insomnia as a cross-sectional and longitudinal predictor of loneliness: Findings from six samples. *Psychiatry research*, *253*, 116-128.

Jetten, J., Haslam, C., & Alexander, S. H. (Eds.). (2012). *The social cure: Identity, health and well-being*. Psychology press.

Kabrita, C. S., & Hajjar-Muça, T. A. (2016). Sex-specific sleep patterns among university students in Lebanon: impact on depression and academic performance. *Nature and science of sleep*, *8*, 189.

Kurina, L. M., Knutson, K. L., Hawkley, L. C., Cacioppo, J. T., Lauderdale, D. S., & Ober, C. (2011). Loneliness is associated with sleep fragmentation in a communal society. *Sleep*, *34*(11), 1519-1526.

Lowe, B., Kroenke, K., Herzog, W., & Gräfe, K. (2004). Measuring depression outcome with a brief self-report instrument: sensitivity to change of the Patient Health Questionnaire (PHQ-9). *Journal of affective disorders*, *81*(1), 61-66.

Masi, C. M., Chen, H. Y., Hawkley, L. C., & Cacioppo, J. T. (2011). A meta-analysis of interventions to reduce loneliness. *Personality and Social Psychology Review*, *15*(3), 219-266.

McHugh, J. E., Casey, A. M., & Lawlor, B. A. (2011). Psychosocial correlates of aspects of sleep quality in community-dwelling Irish older adults. *Aging & mental health*, *15*(6), 749-755.

Milette, K., Hudson, M., Baron, M., Thombs, B. D., & Canadian Scleroderma Research Group*. (2010). Comparison of the PHQ-9 and CES-D depression scales in systemic sclerosis: internal consistency reliability, convergent validity and clinical correlates. *Rheumatology*, *49*(4), 789-796.

Morin, C. M., Bastien, C., Guay, B., Radouco-Thomas, M., Leblanc, J., & Vallières, A. (2004). Randomized clinical trial of supervised tapering and cognitive behavior therapy to facilitate benzodiazepine discontinuation in older adults with chronic insomnia. *American Journal of Psychiatry*, *161*(2), 332-342.

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of personality assessment*, *66*(1), 20-40.

Santini, Z. I., Jose, P. E., Cornwell, E. Y., Koyanagi, A., Nielsen, L., Hinrichsen, C., ... & Koushede, V. (2020). Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): a longitudinal mediation analysis. *The Lancet Public Health*, *5*(1), e62-e70.

Sing, C. Y., & Wong, W. S. (2010). Prevalence of insomnia and its psychosocial correlates among college students in Hong Kong. *Journal of American college health*, *59*(3), 174-182.

Staner, L. (2010). Comorbidity of insomnia and depression. *Sleep medicine reviews*, *14*(1), 35-46.

Taylor, D. J., Bramoweth, A. D., Grieser, E. A., Tatum, J. I., & Roane, B. M. (2013). Epidemiology of insomnia in college students: relationship with mental health, quality of life, and substance use difficulties. *Behavior therapy*, *44*(3), 339-348.

Zimmerman, M., Ellison, W., Young, D., Chelminski, I., & Dalrymple, K. (2015). How many different ways do patients meet the diagnostic criteria for major depressive disorder?. *Comprehensive psychiatry*, *56*, 29-34.

Appendices

Appendix 1.1 Author Guidelines for Submission to SLEEP Journal

Instructions to Authors

SLEEP® is the official publication of the Sleep Research Society (SRS).

Online Submission Information

All materials are submitted and edited electronically using ScholarOne. To submit an original manuscript, review article, editorial, letter to the editor or journal club reviews, please go to ScholarOne Manuscript Central. Complete instructions for the electronic submission process can be found on that site.

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Original Articles present original research findings in the fields of sleep/circadian medicine and sleep/circadian science, broadly defined. There is no minimum or maximum length for Original Articles, but reductions in manuscript length (including numbers of figures and/or tables) may be required as an outcome of peer review. The submission of incomplete data sets, partial cohorts, or pilot data is discouraged. SLEEP® does not publish Original Articles that describe individual patient-based case reports or case series that lack a comparator or control group and thus lacks analytical components for hypothesis testing.

Review Articles

Review articles are critical evaluations of material that has already been published. An author of a review article should consider the progress of current research toward clarifying a problem. A review paper should summarize previous investigations in order to inform the reader of the state of current research; identify relations, contradictions, gaps, and inconsistencies in the literature; and suggests the next step or steps in solving the problem. The review section may also include summaries of symposia presentations at national or international meetings.

Editorials and Letters to the Editor

Editorials have a maximum word length of 1,500 words plus as many references as needed, and may include one figure or table. Letters to the editor should be no more than 1,000 words plus references,

which should be limited to a maximum of ten, and may include one figure or table. Replies to Editorials or Letters to the Editor may be solicited by the Editor in Chief and published together in the same journal issue. A limited number of case reports will be considered as Letters to the Editor.

Journal Club Reviews

Journal Club Reviews are authored by Sleep Research Society trainee members. These reviews are a summary, critical review and discussion of impact/significance of on an article recently published in SLEEP and should be written in the style of an Editorial, with no abstract, significance statement or subheadings. Maximum length is 2,000 words and may include one figure or one table. There are no restrictions on the number of citations. Eligible authors are graduate students and postdoctoral research fellows who are current trainee members of the Sleep Research Society. Co-authored manuscripts are encouraged but not required. SRS membership number(s) must be stated during online submission for all eligible authors.

Essential Elements of Manuscript Submission

Guidelines for Statistical Analysis

Accurate use of statistical methods is a prerequisite for publication in *SLEEP*®. Statistical methods must be rigorous irrespective of the type of publication and reporting of statistical findings must be accurate and complete. Editors can request an expert statistical review of all submissions, particularly if there are methodological questions or concerns. Guidelines for statistical methods and reporting for manuscripts submitted to *SLEEP*®.

Clinical Trial Registration

In accordance with the Clinical Trial Registration Statement from the International Committee of Medical Journal Editors (ICMJE), all clinical trials published in SLEEP must be registered in a public trials registry at or before the onset of participant enrollment. In agreement with the ICMJE, SLEEP defines a clinical trial as "any research project that prospectively assigns human subjects to intervention and concurrently assigned comparison groups to study the cause-and-effect relationship between a medical intervention and a health outcome." For any clinical trials commencing prior to 2008, retrospective registration will be accepted.

The registry must be accessible to the public at no charge, searchable, open to all prospective registrants, managed by a not-for-profit organization, and include all the necessary information as specified by the ICMJE. A list of recommended registries can be found on the ICMJE website at the link provided above. Results posted in the same clinical trials registry in which the primary registration resides will not be considered prior publication if they are presented in the form of a brief abstract (500 words or less) or a table.

Upon manuscript submission, the corresponding author must provide the registry's URL and the trial's registration number at the end of the manuscript's abstract. This information is required for manuscripts reporting the primary analysis of an original clinical trial, and for all partial and secondary analyses of original trials. This information will be published in the journal if the article is accepted.

Ethics of Investigation

Authors should specify within the manuscript whether ethical standards were used in their research. If results of an experimental investigation in human or animal subjects are reported, the manuscript should describe the approval by an institutional review board on human or animal research, and the

appropriate informed consent procedures for human subjects. If approval by an institutional review board is not possible, then information must be included indicating that clinical experiments conform to the principals outline by the Declaration of Helsinki.

Privacy and Informed Consent

Authors must omit from their manuscripts and figures any identifying details regarding patients and study participants, including patients' names, initials, Social Security numbers, or hospital numbers. If there is a possibility that a patient may be identified in text, figures, photos or video, authors must obtain written informed consent for use for in publication of print, online, and licensed uses of *SLEEP*®, from the patient or parent or guardian and provide copies of the consent forms to *SLEEP*®. In such cases where the patient may be identified, authors must indicate that they have obtained informed consent in their manuscript. In addition, all authors are responsible for ensuring that their manuscript and figures comply with the Health Insurance Portability and Accountability Act (HIPAA).

Publication Ethics

Authors should observe high standards with respect to publication ethics as set out by the Commission on Publication Ethics (COPE) and International Committee of Medical Journal Editors (ICMJE). Falsification or fabrication of data; plagiarism, including duplicate publication of the authors' own work without proper citation; and misappropriation of work are all unacceptable practices. Cases of ethical misconduct are treated very seriously and will be dealt with in accordance with COPE guidelines.

The US Office of Research Integrity defines scientific misconduct and includes these behaviors:

- Falsification of data: ranges from fabrication to deceptive reporting of findings and omission of conflicting data, or willful suppression and/or distortion of data.
- Plagiarism: The appropriation of the language, ideas or thoughts of another without crediting their true source and representation of them as one's own original work.
- Improprieties of authorship: improper assignment of credit, such as excluding others, misrepresentation of the same material as original in more than one publication, inclusion of individuals as authors who have not made a definite contribution to the work published, or submission of multi-authored publications without the concurrence of all authors.
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- Violation of generally accepted research practices: serious deviation from accepted practices in proposing or carrying out research, improper manipulation of experiments to obtain biased results, deceptive statistical or analytical manipulations, or improper reporting of results.
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Authorship

All authors listed on the manuscript should have contributed significantly to the design or implementation of the experiment or the analysis and interpretation of the data. Any other individuals who contributed to the experiment or the writing of the manuscript should be listed in the Acknowledgment section. During online submission, the corresponding author must certify on behalf of all authors have read and approved the submitted version.

Dual Authorship

Dual co-first authorship may be indicated on the title page of the manuscript with a statement that the two first authors have contributed equally to the manuscript. If co-authorship is indicated, it is the understanding of the Editors that all authors of the manuscript agree to this designation.

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Details of Style

People-Centered Language

Guidance for improving the language researchers use to talk to and about people with studied health conditions has been issued in several fields. The Editors of *SLEEP*® endorse the use of people-centered language in research communications. Our recommendations for people-centered language for sleep/circadian research publications can be found on this page.

Language

Papers should be clearly and concisely written in good English. Authors whose native language is not English should consult someone fluent in English prior to submission of the manuscript. Alternatively, a professional language-editing service can be used. Manuscripts may be returned to authors for revision for English language.

Sleep Medicine Terminology

Follow the terminology usage recommendations in the AASM Style Guide for Sleep Medicine Terminology.

Abbreviations

Please note that journal style for the abbreviation of standard deviation is SD. Please do not use SD as an abbreviation for sleep deprivation.

Each abbreviation should be expanded at first mention in the text and listed parenthetically after expansion.

Drug Names

Use generic names in referring to drugs; trade names may be given in parentheses after the first mention, but the generic name should be used thereafter.

Reference Style

SLEEP uses the American Medical Association 10th Edition style guide.

For abbreviations of journal names, refer to “List of Journals Indexed in Index Medicus.”

Manuscript Format Requirements

Manuscript should be provided in Microsoft Word.

Pages should be numbered.

Lines should be double spaced.

Do not number the lines.

Manuscripts should be structured using the following components:

Title Page (Page 1 of manuscript)

- Title and Subtitle (if applicable). Please do not include a running title
- Authors and Author affiliations (identify the institution where the work was performed)
- Corresponding author's name, full address and current, valid email address

Abstract (Page 2 of manuscript)

Each original manuscript and review article must be preceded by an abstract. Abstracts are not required for letters to the editor and editorials.

The abstract is limited to 250 words. The components of this format are (start each on a new line): Study Objectives, Methods, Results, Conclusions and Keywords. Conclusions should not simply restate results, but should address the significance and implications of the findings. Authors have the option of not using section headings and may submit a single paragraph, narrative abstract of 250 words maximum length. Abstracts should include as few abbreviations as possible, must follow the title page and should begin on a new page

Keywords

Abstracts must be followed by no fewer than three but no more than ten keywords that reflect the content of the manuscript. For guidance consult the Medical Subject Headings - Annotated Alphabetic List, published each year by the National Library of Medicine.

Clinical Trials

State the details of Clinical Trials: name, URL, and registration

Statement of Significance

Each original manuscript and review article must be preceded by a Statement of Significance. A statement of significance is not required for letters to the editor, editorials or Journal Club reviews.

The Statement of Significance is limited to 120 words and must follow the abstract.

The Statement of Significance should provide a clear statement of the importance and novelty of the research, using language that can be understood by scientists or clinicians without special knowledge of the field. It should include a statement about critical remaining knowledge gaps and/or future

directions of the work. For basic science papers, include a reasonable statement about human disease relevance and/or translational implications.

The statement should not be repetitious with the abstract or the “In summary…” paragraph that is often placed at the end of the Discussion. It should not contain references, numbers, description of methods, abbreviations, or acronyms, unless necessary.

Introduction

State the objective of the reported research, with reference to previous work.

Methods

Describe methods in sufficient detail so that the work can be duplicated, or cite previous descriptions if they are readily available.

Results

Describe results clearly, concisely, and in logical order. When possible give the range, standard deviation, or standard error of the mean, and statistical significance of differences between numerical values.

Discussion

Interpret the results and relate them to previous work in the field. Include a paragraph near the end of the discussion that briefly lists the limitations of the study.

Acknowledgments

The minimum compatible with the requirements of courtesy should be provided. Umbrella groups and specific author contributions may be listed in this section.

Disclosure Statement

The Disclosure Statement is required for all categories of papers (including letters to the editor,editorials and Journal Club reviews).

The Disclosure Statement includes:

- Financial arrangements or connections that are pertinent to the submitted manuscript. If there are no interests to declare use the statement: Financial Disclosure: none.
- Non-financial or conflicts of interest that could be relevant in this context should also be disclosed. If there are no non-financial interests to declare use the statement: Non-financial Disclosure: none

Preprint Repositories

Disclose the appearance of the manuscript in a recognized repository such as bioRxiv or any form of media that is not a preprint repository. For full guidelines please see Conflict of Interest above.

Citations within Text/Reference List

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A standard bibliography program such as EndNote or Reference Manager may be used. We cannot guarantee that citation/reference software will match all *SLEEP*® author guidelines.
Accuracy of reference data is the responsibility of the author. Failure to initially comply with the journal's style requirements may result in manuscripts returned to authors for correction and may potentially delay publication.

Citations within the Text

- Each reference should be cited in the text, tables, or figures in consecutive numerical order by means of Arabic numerals placed in brackets and outside periods and commas and inside colons and semicolons.
- When three or more references are cited at one place in the manuscript, a hyphen should be used to join the first and last numbers of a series.
- Commas should be used without spaces to separate other parts of a multiple-reference citation.

Sample citations within the body of a paper

- According to our previous work,[1,3-8,19]
- The patients were studied as follows[3,4]

Reference List

- Provide all authors' names when fewer than seven; when seven or more, list the first three and add et al.
- Provide article titles and journal name. For abbreviations of journal names, refer to "List of Journals Indexed in Index Medicus."
- Provide year, volume, issue and inclusive pages.
- Provide DOIs and URLs when appropriate.

Sample references:

- Journal Article:
    1. Rainier S, Thomas D, Tokarz D, et al. Myofibrillogenesis regulator 1 gene mutations cause paroxysmal dystonic choreathetosis. Arch Neurol. 2004; 61 (7): 1025–1029.
    2. Lehert P, Falissard B. Multiple treatment comparison in narcolepsy: a network meta-analysis. Sleep. 2018; 41 (12). doi.org/10.1093/sleep/zsy185.

  Book:

    3. Modlin J, Jenkins P,. Decision Analysis in Planning for a Polio Outbreak in the United States. San Francisco, CA: Pediatric Academic Societies; 2004.

Figure Captions

A list of figures: Figure number, title and captions should appear in manuscript following references.

Figures and Tables

Figure Guidelines

The following graphics can be submitted as figures: charts, graphs, illustrations, and photographs. Use color where appropriate. There is no charge for color.

Remove figures from the manuscript: Submit figures separately, one per file.

Figures must be cited, consecutively, in the manuscript text.

Figures should be numbered using Arabic numerals (e.g., Figure 1, Figure 2 etc.).

Figure resolution must be a minimum of 300 dpi.

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Acceptable file types: .tif, .eps, or .pdf files.

Charts and graphs that are built in a Word document or an Excel spreadsheet can be submitted as a Word .doc file or an Excel .xls file.

Figure titles and captions should appear together in a list, placed after the manuscript text.

Multi-part figures: Assemble the parts into one file rather than sending several files. Do not submit Fig 1 a, Fig 1 b, Fig 1 c. Instead submit Fig 1 a-c.

Symbols and abbreviations should be defined within the figure or in the figure caption or together in a key.

Type within figures must be legible in the final pdf. Avoid the use of italic and bold unless necessary.

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Photographs of subjects in which the individual is identifiable require a signed model release.

Table Guidelines

Tables must not duplicate data reported in the manuscript text or figures.

Each table must be self-contained and comprehensible without referring to the manuscript

Each table should begin a new page

Tables may be included in the manuscript document following the Reference List and/or Figure Captions List.

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Tables must be cited, consecutively, in the manuscript text.

Tables should be numbered using Arabic numerals (e.g., Table 1, Table 2 etc.)

Tables should be formatted to fit the width of the page (use landscape when necessary.)

Tables must be editable, created using the table function in Microsoft Word or in Excel.

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Each table must have a corresponding short title above the table and caption below.

Symbols and abbreviations should be defined within the table caption or together in a key.

Footnotes should be marked with superscript lowercase letters or symbols and not marked with numbers (Arabic or Roman numeral).

All footnotes should be fully expanded in the table caption.

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While discouraging indiscriminate use of supplemental materials, some forms of data (videos and large datasets, explanations of data sources, details of computational algorithms) may be appropriately presented as supplemental material. Supplemental material must be directly relevant to the conclusions offered in the main text but non-essential for reader understanding. Information that is essential to understanding the article must not be provided as supplemental material.

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Captions and file names should be numbered sequentially using Figure S1, Table S1, Data set S1 etc.

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Review Process

The Editor-in-Chief and/or Associate Editors first determine if a submitted manuscript is suitable for review and publication. Manuscripts selected are then sent for peer-review to reviewers who are selected based on their expertise related to the particular manuscript. After reviews are submitted, a recommendation of accept, reject or revise (for further consideration) is made by the Associate Editor to the Editor-in-Chief, who makes the final decision. A decision of reject is final and no resubmission of the same or largely the same paper is permitted.

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If a manuscript is returned to the author(s) for revisions, all resubmissions must follow the Instructions for Submitting a Manuscript and include the following:

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Two versions of the revised manuscript must be prepared: a clean manuscript and a marked manuscript showing changes, using highlights, colored text or the Track Changes feature etc. (do not show deletions).

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Once an article appears in an issue, both versions of the paper continue to be accessible and citable.

Disclaimer

Appendix 1.2 – Search Strategy

Author title, abstract and keyword search terms (used across all databases)

Cognitive behavioural therapy terms: (cognitive within three words of (treat OR therapy)

OR cognitive behav* therapy OR cognitive behave* treat* OR behav* therapy OR cognitive therapy OR CBTI

Insomnia terms: (insomnia OR insomni* OR chronic insomnia OR sleep OR sleep prob*)

Old age terms: (old* within 3 words of adult OR person OR people OR woman OR man OR male OR female) OR late life OR elderly OR ageing

(* denotes the truncation command where the search will identify all words beginning with that term)

Separate databases were searched using the same terms, matched to the database thesaurus. The final search combining insomnia, CBT and old age terms were combined using the Boolean operator AND.

Appendix 1.3 - Data Extraction Tool

Data Extraction Tool

Study Title:

Study Authors:

Study Design:

Sample Size:

How was the sample obtained?

Sample characteristics (including age, gender ratio)

Groups similar at pre-test or adjustments

Interventions used (Specific CBT components):

Who delivered the treatment intervention (their training/qualifications)

Sleep medication use?

Description of Intervention/Protocol (how many groups, was the treatment protocol manualised?)

Randomisation Process:

Specific outcomes used to measure levels of Insomnia:

Specific outcomes of insomnia measured:

Information on rater blinding to treatment allocation?

Intention to treat analysis offered/handling of drop outs described, if attrition rate exceeds 15%

Statistical Analysis used?

Effect sizes documented?

Any additional details:

Appendix 1.4 Quality Rating Scale

Quality Rating Scale

(Adapted from the Clinical Trials Assessment Measure, Tarrier & Wykes 2004)

Reviewer:

Title:

Authors:

Date:

Journal:

Sample (Maximum score = 15)

1. Is the sample a convenience sample (score 2) or a geographic cohort (score 5) or highly selective sample e.g. volunteers (score 0) (*Convenience sample: e.g. clinic attendees, referred patient., geographic cohort: all eligible individuals in a given area*).

2. Is the sample size greater than 27 participants per group (score 5) or based on adequate and described power calculations (score 5). If no to both questions, then score 0.

3. Is data provided on the characteristics of refusers/drop out? Yes (score 5) No (score 0).

Total: /15

Control groups (maximum score = 26)

1. Is there a control group? Yes (score 5)

2. Is the control group TAU (score 6) and/ or a control group that controls for non-specific effects or other established or credible treatment (score 10).

3. Groups similar at pre-test? Or adjustments made? (score 5)

Total: /26

Allocation (maximum score = 16, if no control group – score 0 for section)

1. Is there true random allocation or minimisation allocation to treatment groups (if yes score 10)

2. Is the process of randomisation described (score 3)

3. Is the process of randomisation carried out independently from the trial research team (score 3)

Total: /16

Outcome assessment (maximum score = 39)

1. Are the assessments carried out by independent assessors and not therapists (score 10)

2. Were standardised outcome measures used to assess outcomes (yes - score 5/partically score 3) or were participant perspectives of symptoms used only (score 3 if only the latter)

3. Were the outcome measures of insomnia used valid and reliable? (Yes score 5, no score 0)

4. Was there a long term follow up measurement of at least 6 months duration of insomnia, post treatment completion (if yes score 3)

5. Are assessments carried out blind (masked) to treatment group allocation (score 10)

6. Are the methods of rater blinding adequately described (score 3)

7. Is rater blinding verified (score 3)

Total: /39

Analysis (maximum score = 20)

1. The analysis is appropriate to the design and type of outcome measure (score 5)

2. The analysis includes all those participants as randomised (sometimes referred to as an intention to treat analysis) (score 6) and an adequate investigation and handling of drop outs from assessment if the attrition rate exceeds 15% (score 4)

3. Was an effect size calculation completed (score 5) and if not was there sufficient information provided for effect sizes to be completed by the reader (score 3)

Total: /20

CBT for insomnia (maximum score = 31) (complete)

1. Was the CBTI intervention adequately described to allow replication? (score 5)

2. Were the CBT components used appropriate and in line with the evidence base for CBTI (score 5)

3. Was a treatment protocol or manual used to allow for consistency of treatment delivery (score 5)

4. Was information provided on the training of therapists (score 3) were therapists adequately trained to deliver CBT (if yes to both score 5)

5. Was adherence to treatment protocol assessed (score 5)

6. Was subject retention for the CBT intervention 85% or higher (score 3)

7. Were recommendations provided for improving the intervention? (score 3)

Total: /31

Total Score for Paper:

Calculated as percentage:

Appendix 1.5 Breakdown of CTAM quality rating scores for each included study

Paper	**Sample (Maximum score = 15)**	**Control groups (maximum score = 26)**	**Allocation (maximum score = 16)**	**Outcome assessment (maximum score = 39)**	**Analysis (maximum score = 20)**	**CBT for insomnia (maximum score = 31)**	**Total score for paper (maximum = 147)**	**Quality Rating** **49% or less = Low** **50-74% = Medium** **75% or more = High**	**Inter-rater concordance, for double rated studies**
1. McCrae et al (2018)	15	20	10	30	20/20	21	116 **= 79%**	**High**	
2. Alessi et al (2016)	12	20	16	23	20	21	112 **= 76%**	**High**	
3. Irwin et al (2014)	10	20	16	23	18	23	110 **= 76%**	**High**	**96%**
4. Martin et al (2017)	7	20	10	20	18	26	101 **= 69%**	**Medium**	**97%**
5. Tanaka et al (2019)	12	26	16	5	14	19	92 **=63%**	**Medium**	
6. Sadler et al (2018)	2	20	16	8	14	31	91 **= 62%**	**Medium**	
7. Dolu et al (2018)	7	26	0	10	14	11	68 =**46%**	**Low**	**96%**

Appendix 1.6 Practice Points & Research Agenda

Practice Points

- Insomnia is common within the older adult population
- Non-pharmacological treatment options for insomnia are not suitable for long term use
- CBTI and its components is a safe and effective treatment method in reducing symptoms of insomnia in older adults, with effects maintained at follow up.
- Self-reported measures of insomnia tend to overestimate treatment effects compared to objective outcomes

Research Agenda

- Studies investigating the efficacy of CBTI in older adults are lacking
- Larger, high quality longitudinal studies, investigating the efficacy of CBTI are needed to assess the long-term efficacy of the intervention
- Studies using both objective and subjective outcomes to measure treatment efficacy are

Appendix 2.1 Study Flyer

University of Glasgow
Institute of Health & Wellbeing

NHS Greater Glasgow and Clyde

Study Flyer

Brief Behavioural Intervention for Post Stroke Insomnia

WHAT IS THE STUDY ABOUT?

This study is interested in exploring the effectiveness of a brief behavioural intervention in people experiencing sleep problems following a stroke.

We are looking to invite people aged 18 who have had a stroke at least 3 months ago but less than 18 months ago and are experiencing sleep problems.

The study would involve completing sleep diaries for approximately 6 weeks as well as trying out strategies aimed at improving sleep.

Please speak to a member of Headway Staff if you would like to find out more about the study.

Appendix 2.2 Participant Information Sheet

Participant information sheet (V11, 03.04.2020)

Study title: The Effectiveness of a Brief Behavioural Treatment for Insomnia (BBTI), in the management of Post Stroke Insomnia: A pilot study

Information Sheet

My name is Kirsty McDonald and I am undertaking a project as part of my Doctorate in Clinical Psychology. I invite you to take part in this study. However, before you decide whether to do so, I need to be sure that you fully understand why I am carrying out this study and what it would involve if you agreed. I am therefore providing you with the following information. Please read it carefully and be sure to ask any questions you may have. If you wish further information about the study, please don't hesitate to contact me via the contact details provided.

What is the purpose of the study?

There is a growing body of research indicating that a BBTI may be effective at reducing symptoms of insomnia, including difficulty falling asleep, frequent night-time wakening and early morning awakening, within the general population. A BBTI is a type of talking therapy that tends to be short-term, usually 4 sessions long and does not involve the use of medication. Instead the intervention tends to involve making some changes to a person's daily activities and behaviours that perhaps without realising, are adding to the problem. There has been very little research however in evaluating whether the same intervention is effective for individuals who are experiencing sleep difficulties, commonly referred to as insomnia, after having a stroke. The aim of this study is to determine how effective a BBTI is in reducing symptoms of post stroke insomnia. The study is a pilot study, which means that it

is a small study, consisting of a small number of participants. It aims to determine whether the research procedure used in this study would be suitable for larger scale studies.

The present study will be submitted as part of a research portfolio for a Doctorate in Clinical Psychology at the University of Glasgow.

Who is suitable to take part in the study?

Individuals who are experiencing sleep related difficulties after having a stroke are invited to take part in the study. The stroke must have taken place at least 3 months ago but less than 18 months, prior to your participation in the study. Participants should not have been experiencing insomnia within the previous 3 months leading up to the stroke. Additionally, individuals should not have received any cognitive behavioural therapy in the treatment of their post stroke insomnia.

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What does taking part involve?

Taking part in this study involves attending a 60-minute initial meeting, a 60 minute long intervention session, three 20 minute sessions and finally a follow up meeting lasting approximately 45 minutes. All meetings can take place either at your own home or at a charity in Glasgow called Headway, which specialises in helping people with an acquired brain injury.

The initial 60-minute meeting will involve discussing more about what the study involves, determining your suitability for the study and completing some questionnaires about your mood and current levels of sleep. It is important to gather information on your current sleep activity so as we can compare your sleep patterns before and after taking part in the study. This is called a baseline phase. The baseline phase will last for 7 days. After the completion of the baseline period, you will then start the study intervention which will last 4 weeks in

total. Throughout the 4-week intervention you will have one session with the researcher per week, either over the phone or at your own home. The first week's session will last 60-minutes and the remaining 3 sessions will last 20 minutes, Throughout the duration of the study you will be asked to complete a sleep diary every morning to help the researcher monitor your sleep/wake cycle. Once the 4 weeks have come to an end, you will then return to a 7-day baseline period where your sleep activity will continue to be monitored.

The final meeting, lasting approximately 45 minutes in duration will take place once the study has ended, to obtain feedback and to repeat the questionnaires completed in the first meeting.

Participants will be given a workbook to keep which includes information covered in the sessions to use as a reference point throughout the study and after its completion.

Who is conducting the research?

Kirsty McDonald, a Trainee Clinical Psychologist from the University of Glasgow is carrying out this study. It is being supervised by Dr Maria Gardani and Professor Tom McMillan also from the University of Glasgow, as well as Dr Eleni Pataraki, who works within the NHS. All data recorded from the study will be anonymised. Only those who are on your care team or in the research team will be able to view the data. Additionally, the sponsor of the study, NHS GG&C, may also need to access participants identifiable information to ensure the study is being carried out correctly.

Do I have to take part?

No, participation is voluntary, and it is up to you to decide. If you would like to take part, you will be asked to sign a consent form to show you have agreed. If you would like to take a break during any part of the study, you would be free to do this. You would also be free to withdraw from the study at any time, and you would not have to give a reason for this. Withdrawing from the study would not affect the standard of care you receive or your future treatment.

What happens to the information?

Information sheets completed by participants e.g. outcome measures and sleep diaries will be stored in a locked briefcase, within a locked cabinet on NHS premises. Similarly participant information that will be stored on a computer will be fully anonymised and will be stored on NHS and University desktop computers, which are password secured. All data will be stored in accordance with the Data Protections Act as well as EU, UK, University of Glasgow and NHS policy for the duration of 10 years. After 10 years, the data will be destroyed.

Will you contact my GP?

With your consent, the researcher will inform your GP that you are participating in the study. If you would like to see an example of the letter that would be sent to your GP, please just ask the researcher.

What are the possible negative effects on me?

The intervention may generate a number of emotional reactions in you. These emotions may be positive or negative. Should you experience a negative emotional reaction you will be offered the opportunity to discuss this with the researcher or a member of your clinical support team.

What are the possible benefits of taking part?

You may experience a reduction in your symptoms of insomnia because of taking part in this study. Additionally, by taking part, you are helping us determine whether a brief behavioural intervention for insomnia is also effective for individuals experiencing insomnia post stroke.

Who has reviewed the study?

This study has been reviewed and approved by an NHS Research Ethics Committee and by the NHS Greater Glasgow & Clyde Research and Development department.

What do I do now?

If you are interested in taking part in the study, then please either contact the researcher Kirsty McDonald on the email address or phone number below. Alternatively please complete the note of interest slip attached and send it to the researcher Kirsty McDonald, Trainee Clinical Psychologist, West of Scotland Cystic Fibrosis service, Level 2, Zone 3, Office Block, QEUH, 1345 Govan Road, Glasgow or after completion, hand the note of interest slip to a staff member who will contact the researcher on your behalf. The researcher will then contact you to arrange a suitable time to meet.

If you have any further questions?

You will be given a copy of this information sheet and signed consent form to keep. If you would like more information about the study please contact Kirsty McDonald, University of Glasgow, by email: k.mcdonald.2@research.gla.ac.uk or telephone: 0141 451 6270 or alternatively Dr Maria Gardani, University of Glasgow, by email: maria.gardani@glasgow.ac.uk or telephone: 0141 330 2000.

If you wish to speak to someone not closely linked to the study, please contact Dr Hamish McLeod, Programme Director, Doctorate in Clinical Psychology Programme, University of Glasgow, Section of Psychological Medicine, email: Hamish.McLeod@glasgow.ac.uk

, Tel no:0141 211 3922

Other useful contact numbers to use should you experience any distress out with the study:

NHS 24:**111** In an emergency: **999** Breathing Space:**0800 83 85 87** Samaritans: **116 123**

Your own GP during working hours (9am – 5.30pm, Mon-Fri)

Thank you for taking the time to read this participant information sheet and for any further input you may wish to have.

----------Note of Interest Slip----------

Study title: The Effectiveness of a Brief Behavioural Intervention, in the management of Post Stroke Insomnia

Please complete the following information and either send it to: Kirsty McDonald, Trainee Clinical Psychologist, West of Scotland Cystic Fibrosis service, Level 2, Zone 3, Office Block, QEUH, 1345 Govan Road, Glasgow or alternatively give this slip to your clinician who will contact the researcher on your behalf. *Your personal information will not be used for purposes other than the study*

Name _____

Address _____

_____

Telephone Number _____

Preferred method of contact: Letter ☐ Telephone ☐

I consent to the researcher, Kirsty McDonald, contacting me about the above study ☐

I consent to my clinician contacting the researcher, Kirsty McDonald, on my behalf ☐

Signed _____ Date_____

Appendix 2.3 Consent Form

Participant Consent Form

Researcher contact details:
Kirsty McDonald, University of Glasgow, by email: k.mcdonald.2@research.gla.ac.uk. Telephone: 0141 314 6969
Dr Maria Gardani, University of Glasgow, by email: maria.gardani@glasgow.ac.uk. Telephone: 0141 330 2000

Participant ID Number: _____

Date: _____

Title: A brief behavioural intervention for post stroke insomnia.

Please place your initials in the boxes below

1. I confirm that I have read the participant information sheet dated 03.04.2020 (V11) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care being affected. ☐

3. I am happy for you to advise my GP of my participation in the study ☐

4. I agree that my medical record can be accessed by the researcher, solely to obtain further information on my stroke. ☐

5. I understand that data collected during the study may be looked ☐

at by those individuals who form the research team for the study (the research team is outlined in the information sheet) as well as representatives of the study Sponsor, NHS GG&C, for audit purposes.

6. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
_____	_____	_____

Name of Researcher	Date	Signature
_____	_____	_____

Appendix 2.4 Outcome measures and their psychometric properties for completion in the study

PSQI

The PSQI (Buysse et al, 1989) will be completed pre and post the intervention to monitor whether there has been a change in perceived quality of sleep. A score of 5 or higher indicates poorer sleep. The PSQI has been found to have high test-retest validity and reliability (Buysse et al, 1989).

SCI

The SCI (Espie et al, 2014) will be completed by participants pre and post intervention. The SCI is an 8-item questionnaire, with a higher total score indicating better sleep. The SCI has been shown to be internally consistent, sensitive to change and with high correlation to other sleep screening tools e.g. PSQI (Espie et al, 2014).

The Patient Health Questionnaire (PSQ-9)

The PHQ-9 (Kroenke & Spitzer, 2001) is a 9-item self-report questionnaire, based on how individuals have been feeling over the past two weeks. Evidence supports reliability and validity of the PHQ-9 as a measure of depression in people with physical health difficulties (Kroenke & Spitzer, 2001).

The Generalised Anxiety Disorder (GAD-7)

The GAD-7 (Spitzer et al, 2006) is a 7 item self-reported anxiety questionnaire. Evidence supports the GAD-7 as a measure of anxiety in people with mental health difficulties, with it

demonstrating high internal consistency, good validity and sensitivity to change (Shear et al, 2006).

Mini Montreal Cognitive Assessment (MMoCA)

The mini-MOCA is a brief screening tool designed to detect mild forms of cognitive impairment, with a total score of 7 or lower out of 10, indicating cognitive impairment. The mini-MoCA, is a shorter version of the longer Montreal Cognitive Assessment (MOCA; Nasreddine et al, 2005) screening tool, requiring less time for completion. Mai et al (2013) found participant scores on the mini-MoCA to be highly correlated with the scores obtained on the full version. The mini-MoCA is available to use free of charge and has a completion time of approximately 5 minutes.

References

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research 28:193-213.*

Kroenke, K.,& Spitzer, R.L. *(2001).* The PHQ-9*:* validity of a brief depression severity measure. *J Gen Intern Med, (*16*,),* 606–13.

Mai, L. M., Oczkowski, W., Mackenzie, G., Shuster, A., Wasielesky, L., Franchetto, A et al. (2013) Screening for cognitive impairment in a stroke prevention clinic using the MoCA. *The Canadian Journal of Neurological Sciences, 40(2): 192–197.*

Shear, M. K., Belnap, B. H., Mazumdar, S., Houck, P., and Rollman, B. L. (2006). Generalized anxiety disorder severity scale (GADSS): a preliminary validation study. *Depress Anxiety 23:* pp. 77-82.

Spitzer, R. L., Kroenke. K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch Intern Med.*166(10):1092–1097.

Appendix 2.5 Participant Sleep Diary

Sleep Diary

Week Beginning:

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1. What time did you wake up this morning?							
2. What time did you get out of bed this morning?							
3. What time did you go to bed at last night?							
4. What time did you put the light out last night or attempt to go to sleep at?							
5. How long did it take you to fall asleep?							
6. How many times did you wake in the night?							
7. How long were you awake during the night?							
8. How long did you sleep for altogether?							
9. How much alcohol did you have last night?							
10. Did you take any medication last night?							

(for the last 2 questions please answer using the following scale: 0 = not at all, 1 = slightly, 2 = moderately, 3 = quite a lot, 4 = very

11. How well rested do you feel this morning?							
12. Was your sleep of good quality?							

Espie (2012)

Reference

Espie, C. (2012). *Overcoming insomnia and sleep problems: A self-help guide using cognitive behavioural techniques*. Robinson

Appendix 2.6 Session by session account of the BBTI based on the protocol by Troxel et al (2012).

Session 1:

The first BBTI session will be a one to one, 1 hour long, face to face intervention. This session will offer background information on sleep including the mechanisms of sleep as well as healthy sleep behaviours in line with sleep hygiene recommendations. A workbook exploring 'good' and 'bad' sleep habits is then provided to the participant with discussion around this taking place. This workbook is also used as a way of guiding discussion toward processes that control sleep. A personalised sleep schedule will be adapted for each participant, indicating their recommended bed and wake up time, activities to do before bed etc. A general rule for time in bed will be (sleep time + 30 mins, but not < 6 hr).

Session 2 (1 week after session 1):

A 20-minute, face to face meeting at the participant's home, or via telephone. Discussion takes place around how the participant has been finding completing the sleep diary and how their sleep and functioning has been over the past week. Additional general questions are asked about functioning and levels of sleepiness. How well a patient has been able to adhere to the pre-determined sleep schedule will be asked, problem solving any difficulties that may have arisen in achieving this.

Session 3 (1 week after session 2):

A 20-minute, face to face meeting at the patient's home, or via telephone. Review progress and adherence to the protocol, problem solve difficulties and where appropriate, make changes to the sleep schedule. Sleep diaries will indicate the participant's sleep onset latency and wake time after sleep onset. Depending on these levels, adjustments can be made to total

sleep time as well as total time spent in bed. With the new sleep schedule being followed for the next week. Motivational reinforcement will also be offered reminding patients that initial behavioural change is difficult but with time this will become easier.

Session 4 (1 week after session 3):

A 20-minute, face to face meeting at the patient's home, or via telephone. The participant's progress is reviewed, moving on to relapse prevention type strategies. Depending on levels of daytime sleepiness and quality of sleep, time in bed may be increased. This session will have a large focus on rules for better sleep. This understanding is crucial if the participant is to continue with changes made, out with the intervention. Problem solving anticipated potential difficulties may be helpful to the participant in continuing with progress.

Participants will then complete the 7 day return to baseline phase, where they will continue to complete sleep diaries before meeting with the researcher. At this final meeting, data from sleep diaries will be collected. Participants will repeat the outcome measures that they completed at the start for comparison along with the satisfaction questionnaire.

Appendix 3.1 A copy of the email granting permission for Dr Dr Maria Gardani to share the database used in previous studies (Akram et al (2020a, b, c). Dr Gardani was a supervisor of this project and a co-author of the previous studies.

Dr. Christoph Scheepers
Senior Lecturer
School of Psychology
University of Glasgow
62 Hillhead Street
Glasgow G12 8QB
Tel.: +44 141 330 3606
Christoph.Scheepers@glasgow.ac.uk
Glasgow, April 20, 2020

RE: Share Dataset

To whom it may concern,

I understand that Dr Gardani is the local guardian of the data collected on student mental health via online survey from UK students, with ethical approval from Sheffield Hallam University Research Ethics Committee (Protocol number: ER7368595). I further understand that the dataset contains no personally identifying information from the respondents. Given that Dr Gardani is the local guardian of the data and named PI on the corresponding ethics application, I foresee no issues in her sharing the data with her student for purposes of analysis.

Sincerely,

Dr Christoph Scheepers

Dr Christoph Scheepers
Ethics Officer
College of Science and Engineering
University of Glasgow

Appendix 3.2 Four conditions of mediation (Baron & Kenny, 1986)

1) predictor variable must significantly predict outcome variable

2) predictor variable must significantly predict the mediator

3) mediator must significantly predict the outcome variable

4) the predictor variable must predict the outcome variable less strongly when the mediator is added to the equation.

Reference

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173.

Appendix 4 Original Research Proposal

The Effectiveness of a Brief Behavioural Intervention, in the management of Post Stroke Insomnia: A Single Case Experimental Design

MRP Proposal

Version 6

2292990m

Date of Submission to University for Blind Review – 04/08/2018

Abstract

Background: Insomnia is a frequently occurring post stroke symptom, with approximately one third of sufferers experiencing sleep problems 12 months after stroke. Cognitive Behavioural Therapy, has been found to be effective in significantly reducing symptoms of insomnia within the general population. Few studies however have been carried out exploring the efficacy of psychological interventions for post stroke insomnia.

Aims: This study aims to explore sleep patterns amongst participants receiving a brief behavioural treatment intervention (BBTI) for post stroke insomnia. Additionally it will aim to explore the retention and recruitment rate of participants and investigate the potential effectiveness of a brief behavioural treatment intervention (BBTI) for post stroke insomnia.

Methods: Stroke patients (N=6) will be recruited from NHS Outpatient Stroke Services and from local charities. Participants meeting the inclusion criteria will complete a batch of sleep and mood specific questionnaires before being randomly allocated to 1 of 6 differing duration baseline phases (ranging from 5 – 20 days). Once participants have completed their allocated baseline phase they will then go on to complete the 4-week BBTI intervention. Finally, participants will complete a 7 day, post intervention baseline phase. Participants will complete sleep diaries throughout during baseline and intervention stages. The study will take the form of a multiple baseline ABA single case experimental design (SCED), whereby multiple measurements of participant sleep efficiency, sleep duration and sleep onset latency will be recorded during the baseline and intervention phases.

Applications: If the BBTI is found to reduce symptoms of post stroke insomnia, then a larger scale research study could be carried out in future.

Introduction

Stroke & its Impact

Stroke is a major public health concern, causing death and decreased quality of life in people of all ages (Zhang et al, 2012). Ischemic stroke - the most common form, occurs when a blockage reduces blood flow to the brain causing damage to surrounding cells. The extent of brain injury caused depends on the location in which the blockage took place, total duration of blood starvation and the ability of neighbouring healthy cells to compensate for the damaged ones (Chen et al, 2014). Generally, the less damage caused to brain tissue, the more likely that a full recovery will be made (De Meyer et al, 2016).

Post Stroke Insomnia

As well as the physical consequences, many stroke survivors go on to develop psychological difficulties. Meta-analysis suggests that one third of people experience post stroke depression (Hackett, Yapa, Parag & Anderson 2005) and one quarter develop post stroke anxiety (Schottke & Giabbiconi, 2015), with both disorders gaining research interest and consideration of potential treatment options (see Rasquin, Van De Sande, Praamstra, and Van Heugten, 2009 & Broomfield et al, 2011). Sleep associated difficulties are also common post stroke, with Kim et al (2017) identifying symptoms of insomnia to be present in almost two thirds of patients one-month after stroke. Similarly, Glozier et al (2017) found that 34 percent of patients, 12 months post stroke, met the DSM-5 criteria for Insomnia. As well as the distress of the symptom itself, insomnia has been identified as a risk factor for further stroke, suicide and poorer recovery prognosis (Yang et al, 2017). Despite its high prevalence, the impact of insomnia and treatment options amongst stroke survivors has had little consideration.

Treatment for Insomnia

There is a wealth of research supporting the efficacy of talking therapies in the treatment of insomnia within the general population (Okajima, Komada & Inoue, 2011). Cognitive Behavioural Treatment for Insomnia (CBTI) has been reported to be effective in reducing symptoms of insomnia in 70-80% of patients, with long-term improvements being documented (Okajima et al, 2011). CBTI can also be effective for alleviating insomnia symptoms, in the context of other health conditions including: chronic pain (Jungquist et al, 2012), multiple sclerosis (Majendie, Dysch & Carrigan, 2017) heart disease (Conley & Redeker, 2015) and cancer (Ritterband et al, 2012). Despite these positive findings, trials for the efficacy of CBTI secondary to stroke, to the author's knowledge, have not been carried out.

Brief Behavioural Intervention for Insomnia

Patients experiencing insomnia alongside a physical health condition may face specific challenges that limit the patient's willingness and or ability to attend the traditional 6-8 session intervention. Such patients often have multiple commitments and appointments to attend that the prospect of signing up to another 8 sessions can be overwhelming. Troxel, Germain & Buysse (2012) developed a BBTI manualised protocol, with the intervention spanning 4 treatment sessions. The BBTI is based on core CBTI principles for chronic insomnia, as outlined by the National Institute of Health (2005) with the significant difference being that the BBTI comprises predominantly of the behavioural components. Additionally, the intervention provides patients with a workbook which they take home and can refer to throughout the intervention, allowing for continued reinforcement.

This study will aim to deliver a BBTI to participants experiencing post stroke insomnia. The BBTI delivered will be based on the manualised BBTI protocol developed by Troxel et al (2012), however will be specifically tailored to match the needs of the stroke population, e.g. large print workbooks and education on sleep following stroke.

Governing bodies state there should be a thorough period of feasibility and pilot testing when developing complex treatment interventions (Medical Research Council, 2000). Although research within this area has been minimal, a feasibility study looking into the effectiveness of a BBTI for insomnia following brain injury was carried out by Zouharova & Gardani (in preparation). This study, which took the form of a case series design, recruited nine participants and retained six. Four participants demonstrated "clinically significant sleep improvements", one showed "treatment response" and one showed "nonresponse". Compliance with daily diary completion was high.

This study will follow similar research procedures as the feasibility study described above, exploring change in participant sleep efficiency, sleep quality and sleep onset latency post a BBTI, for post-stroke insomnia.

Aims

The primary aim of this study is:

c) To explore change in sleep efficiency amongst participants, post the BBTI, as measured by actigraphy data, a series of sleep outcome measures and sleep diaries.

d) To explore change in participant sleep onset latency and sleep duration as measured by a series of sleep outcome measures, sleep diaries and actigraphy data.

c) To explore the recruitment and retention rate of participants taking part in the study.

The secondary aim of this pilot study is:

a) To determine whether a BBTI for insomnia also reduces symptoms of Anxiety and Depression as measured by the Generalised Anxiety Disorder - 7 (GAD-7) and Patient Hospitalised Questionnaire – 9 (PHQ-9) respectively.

Hypotheses

There is evidence to suggest that healthy individuals who receive a behavioural intervention in the treatment of insomnia experience significant improvements in their insomnia symptoms including faster sleep onset, longer sleep duration and improved subjective quality and actual quality of sleep (Okajima et al, 2011) even in the context of physical health problems e.g. chronic pain (Pigeon et al, 2012; Ritterband et al, 2012).

It is therefore hypothesised that following the completion of the BBTI, participants will experience:

- An improvement in their sleep efficiency
- An improvement in their sleep duration
- An improvement in their sleep latency

Additionally, given the recruitment and retention rates reported in the feasibility study by Zouharova & Gardani (in preparation), it is hypothesised that this study will have a high retention rate of participants.

Methods

Participants

The study will recruit approximately 6 participants (rationale for this is described later). All participants will have experienced either an ischemic or haemorrhagic stroke and will be over 18 years. Due to the intervention requiring participants to complete daily sleep diaries and workbooks, participants must exhibit a good level of cognitive functioning. This will be defined as a score of 8 or more out of 10 on the Mini-Montreal Cognitive Assessment (MMOCA; Mai et al 2013) at point of screening. Stroke induced disability, as measured by the Modified Rankin Scale (Farrell et al, 1991), will be recorded for each participant, with this information being obtained from patient records after patient consent has been obtained. The Caldicott Guardian will be contacted to seek advice as to the correct procedures for obtaining NHS patient records.

Inclusion and Exclusion Criteria

Eligible participants will meet the DSM-5 criteria for insomnia, with levels of insomnia being measured via the Sleep Condition Indicator (SCI; Espie et al, 2014). Participants experiencing other sleep disorders e.g. obstructive sleep apnoea, will also be eligible to enter the study, if the disorder is effectively managed. Exclusion criteria will include individuals with a diagnosis of dementia, epilepsy, an untreated psychotic illness, substance misuse, other neurological disorders and medications known to impact on sleep. Additionally, individuals who are aphasic or unable to write will be unable to take part, due to the study requiring verbal and written data to be recorded. This information will be obtained from looking through the participant record and at point of screening by asking the participant for this information. Individuals experiencing chronic pain, will not be able to take part in the study since chronic pain could interfere with the intervention and results obtained. At point of screening, potential participants will be asked about current levels of pain and completion of the Pittsburgh Sleep Quality Index (PSQI; Buysse et al, 1989) will also offer this information. If participants report significant levels of pain, despite taking pain medication then they would not be eligible to take part in the study.

Recruitment Procedures

Participants will be recruited from a local charity and NHS community stroke services.

Charity recruitment: 'Headway' will be contacted in advance, advising them of the project. The researcher will attend events and clubs run by the charity to recruit participants. Potential participants will be given information sheets and can voice their interest there and then or return the attached freepost ‘note of interest’ slip. The researcher will then arrange to meet with them, on charity premises comparing their circumstances to the inclusion/exclusion criteria. Posters will also be put up on display within charity premises.

NHS Recruitment: The researcher will present details of the study to NHS Community Stroke Services, with potential participants being identified by the Community Stroke Team. Staff will hand out information sheets to patients who they have identified as experiencing symptoms of insomnia and who may be eligible to participate, with patients returning their note of interest slip or alternatively, once made aware of the study, individuals interested in attending can let their key worker know and who can contact the researcher directly. The researcher will then arrange to meet with them, comparing their circumstances to inclusion/exclusion criteria.

At the brief meeting, after reading the participation sheet, participants will be asked to sign a consent form. Consenting participants will be randomly allocated to one of six baseline phases immediately. The available baseline phases are; 5, 8, 11, 14, 17 and 20 days.

Measures

The following outcome measures will be completed by participants pre-and post BBTI, to obtain baseline and intervention related change.

PSQI

The PSQI will be completed pre and post the intervention to monitor whether there has been a change in perceived quality of sleep. A score of 5 or higher indicates poorer sleep. The PSQI has been found to have high test-retest validity and reliability (Buysse et al, 1989).

SCI

The SCI (Espie et al, 2014) will be completed by participants pre and post intervention. The SCI is an 8 item questionnaire, with a higher total score indicating better sleep. The SCI has been shown to be internally consistent, sensitive to change and with high correlation to other sleep screening tools e.g. PSQI (Espie et al, 2014).

The Patient Health Questionnaire (PSQ-9)

The PHQ-9 (Kroenke & Spitzer, 2001) is a 9-item self-report questionnaire, based on how individuals have been feeling over the past two weeks. Evidence supports reliability and validity of the PHQ-9 as a measure of depression in people with physical health difficulties (Kroenke & Spitzer, 2001).

The Generalised Anxiety Disorder (GAD-7)

The GAD-7 (Spitzer et al, 2006) is a 7 item self-reported anxiety questionnaire. Evidence supports the GAD-7 as a measure of anxiety in people with mental health difficulties, with it

demonstrating high internal consistency, good validity and sensitivity to change (Shear et al, 2006).

Mini Montreal Cognitive Assessment (MMoCA)

The mini-MOCA is a brief screening tool designed to detect mild forms of cognitive impairment, with a total score of 7 or lower out of 10, indicating cognitive impairment. The mini-MoCA, is a shorter version of the longer Montreal Cognitive Assessment (MOCA; Nasreddine et al, 2005) screening tool, requiring less time for completion. Mai et al (2013) found participant scores on the mini-MoCA to be highly correlated with the scores obtained on the full version. The mini-MoCA is available to use free of charge and has a completion time of approximately 5 minutes.

Sleep Diaries

Sleep diaries (Espie, 2006) will be completed for the duration of the study. If participants are experiencing unstable sleep patterns throughout the baseline period, prior to BBTI intervention then this will be adjusted for at point of data analysis. Participants will be asked to complete sleep diaries in the morning of each day, with text message reminders being set up to prompt and remind them of this.

A Treatment Acceptability and Credibility Questionnaire, purposely adapted for the study, will be used to assess the patient's overall experience at the end of the intervention. Participants will be asked to rate this on a scale from 0-7 with higher numbers indicating higher levels of satisfaction.

Design & Research Procedures

This study will take the form of a single case experimental design (SCED), aiming to recruit 6 participants (rationale is described later). Participants will be randomly allocated, using a random number generator (www.randomizer.org), to differing baseline durations (ranging from 5 to 20 days). Baseline measurements for sleep onset, total sleep duration and sleep efficiency via sleep diaries and actigraphy data will be collected for each participant for the entirety of the baseline phase. Upon finishing this phase, participants will then commence the intervention stage of the study before it is removed, and participants return to a 7 day baseline phase. Multiple measurements will be recorded throughout each phase of the study. The intervention will be delivered across 4, weekly sessions, with the first session being a 1-hour long session and the remaining 3 sessions being 20 minutes in duration, preferably over the phone or face to face at the participants' home or charity base. Participant adherence and compliance to the protocol will be based on the completion of daily sleep diaries. Sleep diary completion will be reviewed at each session. The first intervention session for each participant will take place at room facilities situated at Headway, which Headway have agreed to (regardless of point of initial recruitment). For an account of what each of the 4 sessions will entail, please see Appendix 1.

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Data Analysis

Visual analysis of the data will be carried out in the first instance, graphing the data collected and visually inspecting any differences between baseline and intervention phases. Historically, it was suggested that in SCED designs, visual inspection of the data demonstrated results that statistical tests failed to find (Bobrovitz & Ottenbacher, 1998). More recently however, it has been acknowledged that visual analysis alone provides some difficulties e.g. collating results for the purposes of meta-analysis and therefore the increased need for statistical testing that offers results for comparison (Tate et al, 2015). Although there is no consensus on which statistical procedure to use in analysing SCED data as such (Bobrovitz & Ottenbacher, 1998), the methods available tend to follow the same principle whereby they measure the extent of non-overlapping data between differing conditions. Tau-

U analyses is one statistical method that controls for baseline trend and has an effect size index that is reported as being suitable in single case research data where parametric assumptions are often not met (Tate et al, 2015). It is unlikely that parametric assumptions would be met in this study and thus this is the most likely statistical test of choice. Paired samples t-tests will be used to compare participant scores on outcome measures pre and post the intervention. Data on recruitment and retention rates will also be reported as will data from the Participant Treatment and Acceptability Questionnaire.

Justification of sample size

One of the aims of this study is to explore participant recruitment and retention rates to inform future larger scale trials. Other than the feasibility study currently under review by Zouharova & Gardani (under preparation), which employed a case series design, no other study to the author's knowledge has been carried out in this area. One paper by Krasny-Pacini & Evans (2018) suggested that SCED designs typically involve a 'small number of participants, typically one to three'. Dallery, Cassidy & Raiff (2013) state that the number of participants in a SCED study is 'always more than 1, usually around 6 but sometimes as many as 20 participants'. There is no clear guidance as to how many participants should be included. Therefore, considering guidance from the literature and the number of participants recruited in the study by Zouharova & Gardani (under preparation) this study will aim to recruit 6 participants.

Settings and Equipment

The intervention will take place in charity premises or in the participant's own home. Workbooks will be given to participants and paper copies of outcome measures will also be required for completion at the start and at the end of the intervention.

Researcher Safety Issues

Due to the potential incorporation of home visits into the study, the researcher will follow local policy guidelines (GG&C Lone working policy, 2014) on lone working. It states that the researcher must always advise another staff member of their whereabouts, devising a 'clock in and clock out' system whereby their location is always accounted for. Additionally, the researcher must always carry a mobile telephone with them and only visit homes where wherever possible it has been deemed safe to do so. A portable pull point alarm will also be carried by the researcher.

Ethical Issues

Prescribed sleep time for participants should be carefully considered, especially in circumstances where the patient may be more vulnerable due to a lack of sleep e.g. long-distance driving, or where getting up from their bed in the night may be difficult due to mobility difficulties.

Additionally, ethical approval will be sought from NHS ethics and management approval from NHS Greater Glasgow and Clyde (GG&C) Research and Design committee. Data will only be used for those purposes approved by ethics committees. All data will be stored securely on the GG&C network and within a locked cupboard which only researchers on the project will have access to.

It is possible that participants may become upset when discussing their symptoms. If the participant does become upset, the researcher will use their skills as a trainee clinical psychologist to assess risk and contain any distress. If there are significant concerns, participant consent will be sought to pass this information on to the participant's GP. Contact details for the researcher and out of hours will be incorporated within participation information sheets (See Appendix 2). Participants will be given information sheets to read which will explain the purpose and process of participation. It will be made

clear that participation is voluntary; participants are free to withdraw from the study at any point, with withdrawal having no impact on their overall treatment plan.

Financial Issues

Workbooks will be needed for each participant to work through, as will sleep diaries and a series of outcome measures for completion. (See Appendix 3) for an estimate of cost.

Timetable

Task	Estimated Time to Complete	Estimated Start Date	Estimated Completion Date
MRP Draft	4 months	September 2017	January 2018
MRP proposal	6 months	January 2018	June 2018
Finalise Proposal and Materials	2 months	June 2018	September 2018
Ethics Submission	2 months	September 2018	October 2018
Recruit and gather data	7 months	October 2018	February 2019
Data Analysis	2 months	February 2019	April 2019
Final write up	3 months	April 2019	July 2019

Practical Applications

If the BBTI is found to reduce participants' symptoms of insomnia, a larger study could be rolled out incorporating larger participant numbers.

The results of the study will be written in the trainee clinical psychologist's thesis and disseminated to Stroke Clinical Psychology Teams and charities as well as at academic meetings and conferences across the country

References

Blackburn DJ, Bafadhel L, Randall M, Harkness K. A (2013). Cognitive screening in the acute stroke setting. *Age Ageing*, 42:113–116.

Bobrovitz, C. D., & Ottenbacher, K. J. (1998). Comparison ofvisual inspection and statistical analysis of single-subject datain rehabilitation research. American Journal of PhysicalMedicine & Rehabilitation, 77, 94–102.

Broomfield, N. M., Laidlaw, K., Hickabottom, E., Murray, M. F., Pendrey, R., Whittick, J. E., & Gillespie, D. C. (2011). Post stroke depression: The case for augmented, individually tailored cognitive behavioural therapy. *Clinical Psychology & Psychotherapy*, *18*(3), 202-217.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index (PSQI): A new instrument for psychiatric research and practice. *Psychiatry Research 28:193-213.*

Chen, J., & SpringerLink (Online service). (2014). *Immunological mechanisms and therapies in brain injuries and stroke*. New York, NY: Springer.

Conley, S., & Redeker, N. S. (2015). Cognitive behavioral therapy for insomnia in the context of cardiovascular conditions. *Current Sleep Medicine Reports, 1*(3), 157-165.

Connelly, L. M. (2008). Pilot studies. *Medsurg Nursing,* 17(6), 411-2.

Dallery, J., Cassidy, R. N., & Raiff, B. R. (2013). Single-Case Experimental Designs to Evaluate Novel Technology-Based Health Interventions. *Journal of Medical Internet Research, 15*(2).

De Meyer, S. F., Denorme, F., Langhauser, F., Geuss, E., Fluri, F., & Kleinschnitz, C. (2016). Thromboinflammation in stroke brain damage. *Stroke, 47*(4), 1165-1172.

Espie, C. A. (2006). *Overcoming Insomnia and Sleep Problems.* London: Robinson.

Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ Open, 4(3), e004183.*

Farrell B, Godwin J, Richards S, Warlow C, et al. (1991). The United Kingdom transient ischaemic attack (UK-TIA) aspirin trial: final results. J Neurol Neurosurg Psychiatry, 54 (12): 1044–1054.

Glozier, N., Moullaali, T., Sivertsen, B., Kim, D., Mead, G., Jan, S., . . . Hackett, M. (2017). The course and impact of poststroke insomnia in stroke survivors aged 18 to 65 years: Results from the psychosocial outcomes in StrokE (POISE) study. *Cerebrovascular Diseases Extra, 7*(1), 9-20

Hackett, M., Yapa, C., Parag, V., & Anderson, C. (2005). Frequency of depression after stroke - A systematic review of observational studies. *Stroke, 36*(6), 1330-1340.

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Res Nurs Health, (31) 180-191.*

Jungquist, C. R., Tra, Y., Smith, M. T., Pigeon, W. R., Matteson-Rusby, S., Xia, Y., & Perlis, M. L. (2012). The durability of cognitive behavioral therapy for insomnia in patients with chronic pain. *Sleep Disorders, 2012*, 1-8.

Kim, W., Jung, H., Choi, H., Park, C., Kim, E., Lee, S., . . . Joa, K. (2017). The associations between insomnia and health-related quality of life in rehabilitation units at 1 month after stroke. *Journal of Psychosomatic Research, 96*, 10-14.

Krasny-Pacini, A. and Evans, J. (2018) Single-case experimental designs (SCEDs) to assess intervention effectiveness in rehabilitation: a practical guide. *Annals of Physical and Rehabilitation Medicine*, (doi:10.1016/j.rehab.2017.12.002).

Kroenke, K.,& Spitzer, R.L. *(2001).* The PHQ-9*:* validity of a brief depression severity measure. *J Gen Intern Med, (*16*,),* 606–13.

Mai, L. M., Oczkowski, W., Mackenzie, G., Shuster, A., Wasielesky, L., Franchetto, A et al. (2013) Screening for cognitive impairment in a stroke prevention clinic using the MoCA. *The Canadian Journal of Neurological Sciences, 40(2): 192–197.*

Majendie, C. M. A., Dysch, L., & Carrigan, N. (2017). Cognitive behavioral therapy for insomnia (CBT-I) for an adult with multiple sclerosis. *Clinical Case Studies, 16*(2), 115-131.

Medical Research Council. (2000). *A framework for the development and evaluation of RCTs for complex interventions to improve health*. London: MRC,

McCurry S. M., Logsdon R. G., Vitiello M. V., Teri L. (1998). Successful behavioral treatment for reported sleep problems in elderly caregivers of dementia patients: A controlled study. *Journal of Gerontology: Psychological Sciences*, 53B:P122-P129.

National Institutes of Health. National Institutes of Health State of the Science Conference statement on manifestations and management of chronic insomnia in adults. (2005). *Sleep, 28*(9):1049–57.

Nasreddine, S., Phillips, N. A., Bédirian, V, *et al.* (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc* **53**: 695–699.

Okajima, I., Komada, Y., & Inoue, Y. (2011). A meta-analysis on the treatment effectiveness of cognitive behavioral therapy for primary insomnia. *Sleep and Biological Rhythms, 9*(1), 24-34

Rasquin, S. M. C., Van De Sande, P., Praamstra, A. J., & Van Heugten, C. M. (2009). Cognitive-behavioural intervention for depression after stroke: Five single case studies on effects and feasibility. *Neuropsychological Rehabilitation, 19*(2), 208-222.

Ritterband, L. M., Bailey, E. T., Thorndike, F. P., Lord, H. R., Farrell. A., Carnahan, L., & Baum, L. D. (2012). Initial evaluation of an internet intervention to improve the sleep of cancer survivors with insomnia. *Psycho oncology, 21*(7), 695-705.

Schottke, H., & Giabbiconi, C. (2015). Post-stroke depression and post-stroke anxiety: Prevalence and predictors. *International Psychogeriatrics*, *27*(11), 1805-1812.

Shear, M. K., Belnap, B. H., Mazumdar, S., Houck, P., and Rollman, B. L. (2006). Generalized anxiety disorder severity scale (GADSS): a preliminary validation study. *Depress Anxiety 23:* pp. 77-82.

Simpson, C., & Carter, P. A. (2010). Pilot study of a brief behavioral sleep intervention for caregivers of individuals with dementia. *Research in gerontological nursing*. Jan; 3(1):19–29.

Spitzer, R. L., Kroenke. K., Williams, J. B. W., & Löwe, B. (2006). A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. *Arch Intern Med.*166(10):1092–1097.

Tate, R. L., Perdices, M., Rosenkoetter, U., Wakim, D., Godbee, K., Togher, L., et al. (2013). Revision of a method quality rating scale for single-case experimental designs and n-of-1 trials: the 15-item Risk of Bias in N-of-1 Trials (RoBiNT) Scale. *Neuropsychol Rehabil* ;23: 619–38.

Troxel, W. M., Germain, A.,&Buysse, D. J. (2012). Clinical management of insomnia with brief behavioral treatment (BBTI). *Behav Sleep Med, 10: 266–79.*