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SYSTEMATIC REVIEW

Efficacy of brief behavioural therapy for insomnia in older adults with chronic insomnia: a systematic review and meta-analysis from randomised trials

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Abstract

Background: chronic insomnia is a highly prevalent and persistent health concern among older adults, and it has significant adverse effects on cognitive function and physical health.
Objectives: the study aimed to evaluate the efficacy of a brief 4-week behavioural therapy for insomnia (BBTi) on insomnia remission in older adults with chronic insomnia.
Design: a systematic review and meta-analysis were conducted.
Subjects: adults aged 60 years or older.
Methods: eight electronic databases were systematically searched through the end of March 2022. Studies followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement.
Results: four randomised controlled trials (190 subjects) were included. The mean age of the participants was 69.06 (65.10–71.65), and 29.9% (27.3–32.3%) were male. Older adults who received the BBTi showed a significant insomnia remission (standardised mean differences, −1.07; 95% confidence interval, −1.43 to −0.71; I^2, 0%). Sleep parameters measured by actigraphy revealed that in older adults, the BBTi program significantly improved total sleep time, wake after sleep onset (WASO), sleep onset latency (SOL) and sleep efficacy (SE) compared to the controls. For the subjective sleep parameters measured the by sleep diary, older adults who received BBTi obtained a more effective improvement in WASO, SE and SOL. The overall risk of bias was mostly low or of some concern due to the difficulty of blinding participants and assessors.
Conclusions: a 4-week BBTi program can be considered an effective and nonselective intervention for insomnia remission among older adults with chronic insomnia and thereby has the potential to ameliorate WASO, SE and SOL.

Keywords: brief behavioural therapy for insomnia (BBTi), older adults, chronic insomnia, systematic review and meta-analysis, older people

Key Points

- A 4-week behavioural therapy for insomnia (BBTi) is a simple and efficacious treatment for insomnia remission among older adults with chronic insomnia.
- The effects of BBTi significantly improved actigraphy-based sleep parameters among older adults with chronic insomnia.
- A 4-week BBTi efficacy was also seen in the sleep diary.
- The discrepancy in total sleep time between actigraphy and sleep diary has been observed in older adults with chronic insomnia.

Introduction

Chronic insomnia has been consistently reported as being more prevalent among older people [1, 2], ranging from ∼12% to 20% [3]. The incidence of insomnia at the 12-month observation increases to 8% for people older than 65 years of age [4]. Insomnia disorder is broadly defined as dissatisfaction with nighttime sleep either qualitatively or quantitatively concurrent with distress or impairment in daytime functioning, such as fatigue, negative mood and poor cognition, despite the influence of other physical, psychiatric or sleep disorders [5]. Both diagnostic systems of The Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5) [6] and The International Classification of Sleep Disorders 3rd Edition (ICSD-3) [7] specify that the symptoms of chronic insomnia should occur at least three nights per week and be present for at least 3 months. The pathophysiology of chronic insomnia is related not only to the hyperarousal state of the brain [8] but also to neurodegenerative changes in older people [9]. Therefore, chronic insomnia has been identified as a prevalent and independent disease related to ageing and even a comorbid disease concurrent with medical or psychological diagnosis in older adults [10], causing increased healthcare utilisation costs, disability and reduced quality of life [11, 12].

Large studies recommend nonpharmacological treatments as first-line management for chronic insomnia in adults [13] and suggest that they should be attempted later in life [14]. Because hypnotics can be efficacious for the short-term treatment of insomnia, they increase the potential risk of adverse effects such as cognitive impairment and injuries [12, 15]. Nonpharmacological treatments include sleep hygiene, stimulus control therapy, relaxation therapy and cognitive–behavioural therapy [16]. Cognitive–behavioural therapy for insomnia (CBT-i) is an effective and prevalent therapy [17] and is superior to benzodiazepine and nonbenzodiazepine sleeping medications for the long-term treatment of insomnia [18].

CBT-i is a technique for treating chronic insomnia in an aged population [19, 20]. It includes cognitive reframing and behavioural changes to address cognitive errors and inappropriate sleep hygiene and behaviours, and it is administered weekly over 4–8 sessions. Cognitive therapy requires time and professional specialists to achieve successful outcomes. The brief behavioural treatment for insomnia (BBTi) was developed to address the barriers of widespread dissemination associated with standard CBT-i, with the goals of being simple, acceptable to patients and more easily administered in a general medical setting. Therefore, the BBTi represents an alternative that is easier to disseminate, as the behavioural components alone can be more easily tailored for administration by a broader range of healthcare professionals [21, 22].

To date, there have been several studies on the effectiveness of BBTi for older adults with chronic insomnia [21–25]. Under different study designs, the number of participants, severity and duration of insomnia, and assessment tools are different, and the efficacy of BBTi in improving sleep quality remains unclear. We aimed to evaluate the efficacy of a brief 4-week BBTi on insomnia remission in older adults with chronic insomnia by using systematic review and meta-analysis methods.

Methods

A protocol was registered in the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY) (registration number: INPLASY202290086). This systematic review was conducted between February and March 2022.

Search strategy

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement [26] (Supplementary Table 1, available in *Age and Ageing* online, shows the PRISMA checklist) to explore the efficacy of a BBTi on improving sleep quality in older adults. Eight electronic databases, namely, Ovid Medline, Embase, Cochrane Library, CINAHL, Scopus, Web of Science (WoS) and ClinicalTrials, were systematically searched to identify relevant articles published through the end of March 2022, without language restrictions. EndNote reference management software was used to manage the citations of all the selected studies for screening, and duplicate records were manually removed in EndNote. The three main concepts of older individuals, BBTi, sleep quality and search strategy, were used with search terms to retrieve relevant studies (Supplementary Table 2, available in *Age and Ageing* online, shows the search strategy).

Inclusion criteria

In the current review, we included all studies conducted on determining the efficacy of BBTi among older adults.

Our inclusion criteria were (i) randomised controlled trials (RCTs) and systematic reviews and meta-analyses, (ii) older adults (aged 60 years and over) with chronic insomnia, (iii) an experimental group that received a brief behavioural therapy intervention, (iv) a control group that received standard care (or no treatment), (v) the primary outcome was related to remission from insomnia and (vi) the study type was an RCT to minimise the risk of bias. The exclusion criteria were (i) patients diagnosed with cognitive dysfunction, mood disorders, sleep-disordered breathing and periodic limb movement disorder and (ii) patients with heavy caffeine or alcohol consumption. Three reviewers screened each record independently.

Outcome variables and measures

Outcome measures were not considered as part of the eligibility criteria.

- Remission from insomnia was assessed by validated scales such as the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). Higher scores on the PSQI or ISI represent poorer sleep quality [27].
- Objective sleep parameters included total sleep time (TST), sleep onset latency (SOL), wake after sleep onset (WASO) and sleep efficacy (SE), as measured by actigraphy.
- Subjective sleep parameters included TST, SOL, WASO and SE, as measured by sleep diary.

Data extraction and methodological quality assessment

Three reviewers independently assessed the methodological quality of RCTs using the Cochrane Collaboration tool for assessing the risk of bias (ROB 2.0) [28]. The six domains used to assess the risk of bias included random sequence generation and allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias [29]. Each individual item was rated as either a low, unclear or high risk of bias. Any disagreements or uncertainty were resolved by discussion with the fourth reviewer [29]. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology was used to assess the certainty of evidence (CoE) regarding the major outcomes reported by each included study, including the risk of bias, consistency, directness, precision and publication bias [30]. The levels of CoE were classified as high, moderate, low and very low [30].

Data synthesis and analysis

A standardised data extraction template was used to collect descriptive information (e.g. study reference, country, mean age, intervention period, retention rate of BBTi, providers of delivering interventions and outcome measures). Review Manager 5.4.1 software (The Cochrane Collaboration, The Nordic Cochrane Centre, Copenhagen, Denmark) was used for data synthesis. For the continuous dependent variable, change scores of sleep quality and sleep parameters were measured by actigraphy and sleep diary. The effect size was defined as the difference between pre- and post-BBTi intervention.

The outcome measures of sleep quality obtained from the PSQI, and ISI are presented as the standardised mean differences (SMDs) between the intervention and control groups with corresponding 95% confidence intervals (CIs). The secondary outcomes were sleep measures, including objective data (TST, WASO, SE) obtained from actigraphy and subjective data (TST, WASO, SE, SOL) obtained from sleep diaries. We combined the outcomes of four RCTs through meta-analysis with a random-effects model, as variability was expected between the studies. Heterogeneity was assessed using the Higgins I^2 statistic. Heterogeneity was considered to be reported if $I^2 > 75\%$ [31]. We only pooled analyses or subgroup analyses if $I^2 < 90\%$.

Results

Literature search

A total of 2,576 articles were identified in the initial search, and 932 articles were removed due to duplication. After the title, abstract and keywords were reviewed, 1,629 articles were excluded because they did not meet the study criteria, leaving a total of 30 full-text articles that were downloaded for consideration. Twenty-two articles were excluded because they were not related to BBTi ($n = 22$) or sleep quality ($n = 2$). Additionally, we found that the same study was reported twice ($n = 3$). We also searched the website, and one additional article was identified. Ultimately, four articles with RCTs designs met all the inclusion criteria and were included in the qualitative synthesis (Figure 1).

Study characteristics

The four RCTs are summarised in Table 1. All RCTs included in the present review were published between 2006 and 2019. All the included studies were conducted in the USA [21, 22, 24, 25]. The total sample size of four studies was 190, with sample sizes ranging from 11 to 82 participants. On average, the participants were 69.06 years old, and 29.93% were male. One hundred two participants were included in the BBTi groups, and 99 participants were enrolled in the control groups. One cross-over study was conducted by Gebara *et al*. [24], and these results are within participants, which cannot be combined with the other parallel group studies. The participants were recruited from among community-dwelling older adults with primary or chronic insomnia. The retention rate of BBTi ranged between 90.9% and 100%.

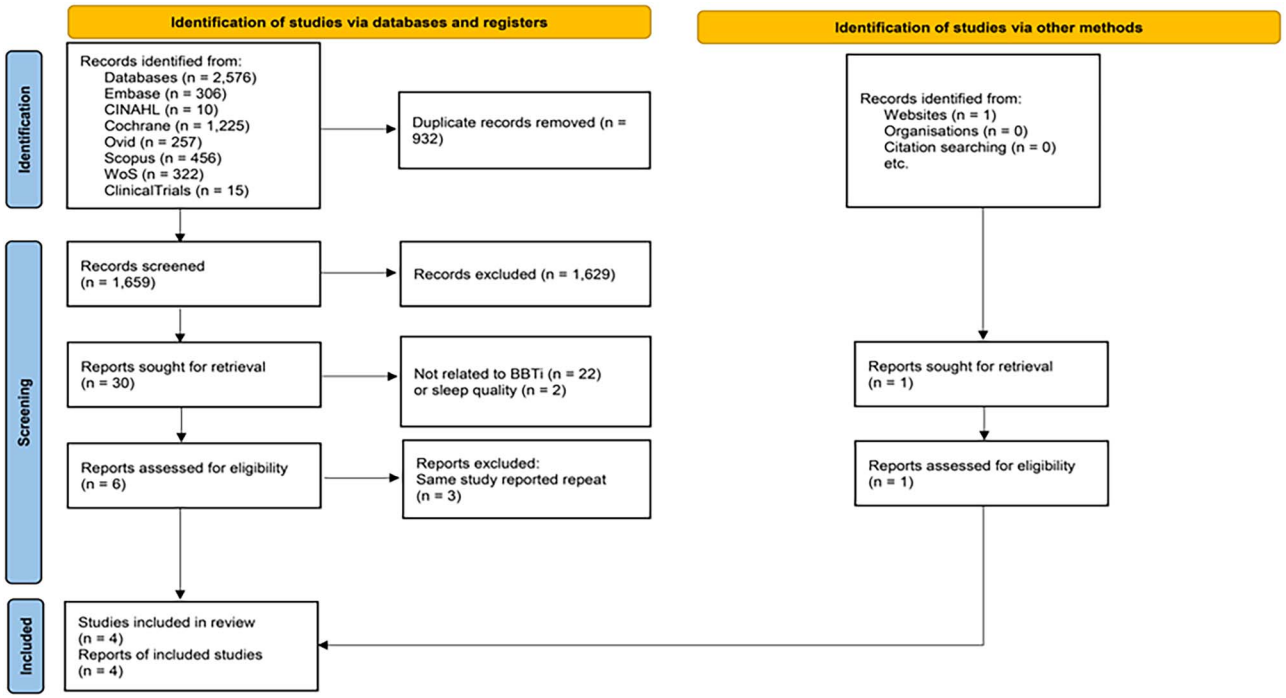


Figure 1. PRISMA 2020 diagram for the literature search and selection process.

Description of the 4-week BBTi interventions

BBTi interventions to relieve insomnia among older adults with chronic insomnia were all individual-based [21, 22, 24, 25]. The BBTi interventions were delivered by a nurse practitioner [21, 22], advanced doctoral students in clinical and counselling psychology [25], and a therapist [24].

The BBTi program was structured and emphasised behavioural interventions, including sleep hygiene education, bedtime restriction and stimulus control, over a period of 4 weeks. In addition, this brief behavioural intervention was not limited to administration by specialised physicians; it was also delivered by primary care nurses [32]. Insomnia remission, our study outcome, was measured using the PSQI, the ISI, sleep diaries and actigraphy. No adverse events were reported in these studies.

Methodological quality assessment of the included studies

Based on the Cochrane risk of bias 2.0 tool, all studies were classified as having a low, high or unclear risk of bias [28]. The results are shown in Supplementary Figure 1 available in *Age and Ageing* online.

Allocation

All included studies were RCTs. Two of four studies (50%) were rated as having some concerns because the lack of description of allocation concealment methods was unclear [24] and because there was baseline (mean age, medications) imbalances [25].

Blinding

Two studies [24, 25] showed an unclear risk of blinding the outcome assessor due to the difficulty in blinding people delivering the interventions.

Incomplete outcome data

All studies showed data on retention. The adherence rate in four studies ranged from 90.9% to 100%, which indicated a low risk for attrition bias.

Selective reporting

Two studies [22, 24] showed an unclear risk of detection bias because of a lack of blinding of the assessors.

Reporting bias

Three studies were rated as having a low risk of reporting bias, as the results are more likely to be reported and available for synthesis [21, 22, 25]. One study was at unclear risk of reporting bias due to a small sample size [24].

Overall risk

The overall risk of bias was mostly low or of some concern [21, 22, 25]. One study was at high risk of overall risk, as the quality of the evidence was questionable [24].

Pooled effect of a 4-week BBTi on the remission from insomnia

Three studies (136 participants) [21, 22, 24] were included in our meta-analysis, and the results with change points

Table 1. Characteristics of the included RCT studies

Study	Country	Study design	Inclusion criteria	No. of patients (% male)	No. of patients with treatment/control	Intervention period	Retention rate of BBTi (%)	Providers of delivering interventions	Outcome measures
Germain *et al.* [21]	USA	Parallel group study design	≥60 years and met diagnostic of primary insomnia	35 (28.6)	17/18	4 weeks	100.0	Nurse practitioner	1. Sleep quality: PSQI 2. Sleep diary: TST, SOL, WASO, SE
Buysse *et al.* [22]	USA	Parallel group study design	≥60 years and met diagnostic of primary insomnia	31 (31.5)	42/40	4 weeks	92.9	Nurse practitioner	1. Sleep quality: PSQI 2. Sleep diary: TST, SOL, WASO, SE 3. Actigraphy: TST, SOL, WASO, SE
McCrae *et al.* [25]	USA	Parallel group study design	≥65 years with chronic insomnia	62 (32.3)	32/30	4 weeks	93.5	Advanced doctoral students in clinical and counselling psychology	1. Sleep quality: self-rating scaled 2. Sleep diary: TST, SOL, WASO, SE 3. Actigraph: TST, SOL, WASO, SE
Gebara *et al.* [24]	USA	Cross-over study design	≥60 years and with psychological problems and insomnia	11 (27.3)	11/11	4 weeks	90.9	Therapist	1. Sleep quality: Insomnia Severity Index 2. Sleep diary: TST, SOL, WASO, SE

NA, not available.

revealed that a 4-week BBTi significantly improved total scores of sleep quality in community-dwelling older adults with chronic insomnia (SMD: −1.07, 95% CI: −1.43, −0.71, $I^2 = 0\%$) (Figure 2).

The efficacy of BBTi on objective sleep parameters: actigraphy

Total sleep time

Of the four studies, two studies (141 participants) [22, 25] objectively estimated the efficacy of BBTi among older adults with chronic insomnia. The pooled efficacy of BBTi demonstrated a decrease in TST (MD: −25.71, 95% CI: −40.66, −10.76, $I^2 = 0\%$) (Figure 3A).

Wake after sleep onset

Of the four studies, two studies (141 participants) [22, 25] objectively estimated the efficacy of BBTi among older adults with chronic insomnia. The pooled efficacy of BBTi demonstrated a decrease in the time of WASO (MD: −9.49, 95% CI: −16.02, −2.96, $I^2 = 0\%$) (Figure 3B).

Sleep efficacy

Of the four studies, two studies (141 participants) [22, 25] objectively estimated the efficacy of BBTi among older adults with chronic insomnia. The pooled efficacy of BBTi demonstrated a significant increase in SE (MD: 3.48, 95% CI: 1.49, 5.47, $I^2 = 0\%$) (Figure 3C).

Sleep onset latency

Of the four studies, two studies (141 participants) [22, 25] objectively estimated the efficacy of BBTi among older adults with chronic insomnia. The pooled efficacy of BBTi demonstrated a decrease in the length of SOL (MD: −9.24, 95% CI: −14.00, −4.47, $I^2 = 0\%$) (Figure 3D).

The efficacy of BBTi on subjective sleep parameters: sleep diary

Total sleep time

Of the four studies, three studies (176 participants) [21, 22, 25] were included in the analysis of the effect of BBTi after intervention, and the results with change points revealed that a 4-week-based BBTi had nonsignificant effects on improved TST in community-dwelling older adults with chronic insomnia (MD: −9.65, 95% CI: −31.81, 12.51, $I^2 = 0\%$) (Figure 4A).

Wake after sleep onset

Of the four studies, three studies (176 participants) [21, 22, 25] were included in the analysis of the effect of BBTi after the intervention, and the results with change points revealed that a 4-week-based BBTi had significant effects on decreasing the time of WASO in community-dwelling

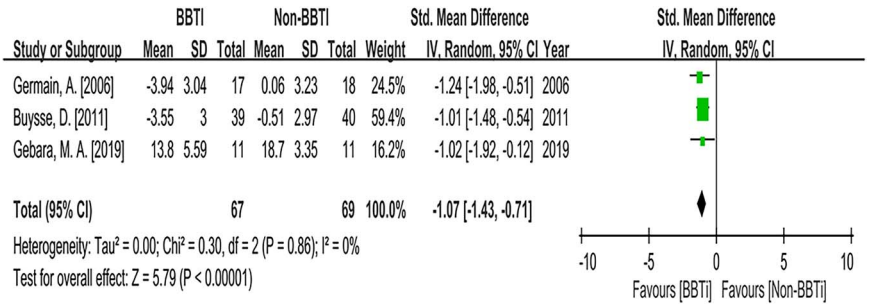


Figure 2. Change point of SMDs in the effect of BBTi on sleep quality (PSQI; ISI) in older adults with chronic insomnia. Note: SD, standard deviation; IV, inverse variance; CI, confidence interval; df, degrees of freedom; Chi², chi-squared statistic; *P*, *P* value; I^2, *I*-squared heterogeneity statistic; *Z*, *Z* statistic.

older adults with chronic insomnia (MD: −20.67, 95% CI: −30.42, −10.92, $I^2 = 0\%$) (Figure 4B).

Sleep efficacy

Of the four studies, three studies (176 participants) [21, 22, 25] were included in the analysis of the effect of BBTi after the intervention, and the results with change points revealed that a 4-week-based BBTi significantly improved the percentage of SE in community-dwelling older adults with chronic insomnia (MD: 7.40, 95% CI: 4.82, 9.98, $I^2 = 0\%$) (Figure 4C).

Sleep onset latency

Of the four studies, three studies (176 participants) [21, 22, 25] estimated the efficacy of BBTi on the effect of BBTi after the intervention. The pooled efficacy of BBTi demonstrated a significant decrease in the length of SL (MD: −20.07, 95% CI: −27.30, −12.84, $I^2 = 0\%$) (Figure 4D).

GRADE assessment and summary of findings

We present the GRADE assessment and a summary of the findings in Supplementary Table 3 available in *Age and Ageing* online. We rated the overall CoE on the effects of BBTi intervention on improving sleep quality and sleep parameters regardless of actigraphy or in the sleep diary as low and very low, respectively. Most included studies at risk of bias showed some concerns and imprecision.

Discussion

This systematic review and meta-analysis are the first to include four RCTs with 190 older adults with chronic insomnia focused on evaluating the effect of brief behavioural therapy on improving sleep quality. The results of our meta-analysis revealed that older adults with chronic insomnia receiving BBTi therapy could achieve significantly enhanced insomnia remission compared with those not receiving therapy. The results were consistent with those of previous studies by Germain *et al*., Buysse *et al*., McCrae *et al*. and Gebara *et al*. [21, 22, 24, 25], who reported that delivering accurate sleep information, including the practice of sleep hygiene and the use of specific behavioural techniques, i.e. relaxation therapy, stimulus control and sleep restriction, could address unrealistic or misinformed expectations regarding sleep, which often perpetuate symptoms of insomnia. Due to this maladaptive behavioural change, sleep-related anxiety is promoted, which improves sleep quality. Our findings suggest that BBTi seems to have the potential to relieve insomnia symptoms in older people with chronic insomnia. However, there are still limited studies examining the effects of BBTi for older adults with chronic insomnia, and differences in study instruments make it difficult to compare the magnitude of treatment effects. More studies are needed to confirm the evidence.

Although our data confirmed that BBTi interventions could relieve insomnia symptoms in older adults, the effects of BBTi on the actigraphically measured TST, WASO, SE and SOL remain uncertain due to the limited number of studies conducted with small sample sizes. The results of our meta-analysis revealed that older adults assigned to the group receiving BBTi reported significantly improved SE [mean difference = 3.48] and decreased by 25.71, 9.49 and 9.24 for actigraphy-based TST, WASO and SL, respectively. One of the behavioural components is bedtime restriction. Restricting the amount of time older adults spend in bed (TIB) as close as possible to their estimated TST may increase SE. Similar results were reported by Buysse *et al*. [22], who found an initial reduction in TST concurrent with improvements in SE and other sleep parameters. While we did observe a decrease in TST following BBTi intervention, this decrease was also observed in older adults receiving a brief CBTI [33]. However, our study's findings were contrary to McCrae *et al*. [25] They did not observe improvement in actigraphy-based SE or SOL following BBTi in an older population. The possible explanations for the inconsistent results could be differences in controlling time interactions. Our results may have overestimated the effects of BBTi because we did not consider the time interactions.

Disagreements in actigraphy-based estimation and sleep diary assessments have been observed not only in community-dwelling older adults [34] but also in older adults with insomnia [35]. Our study also reached similar

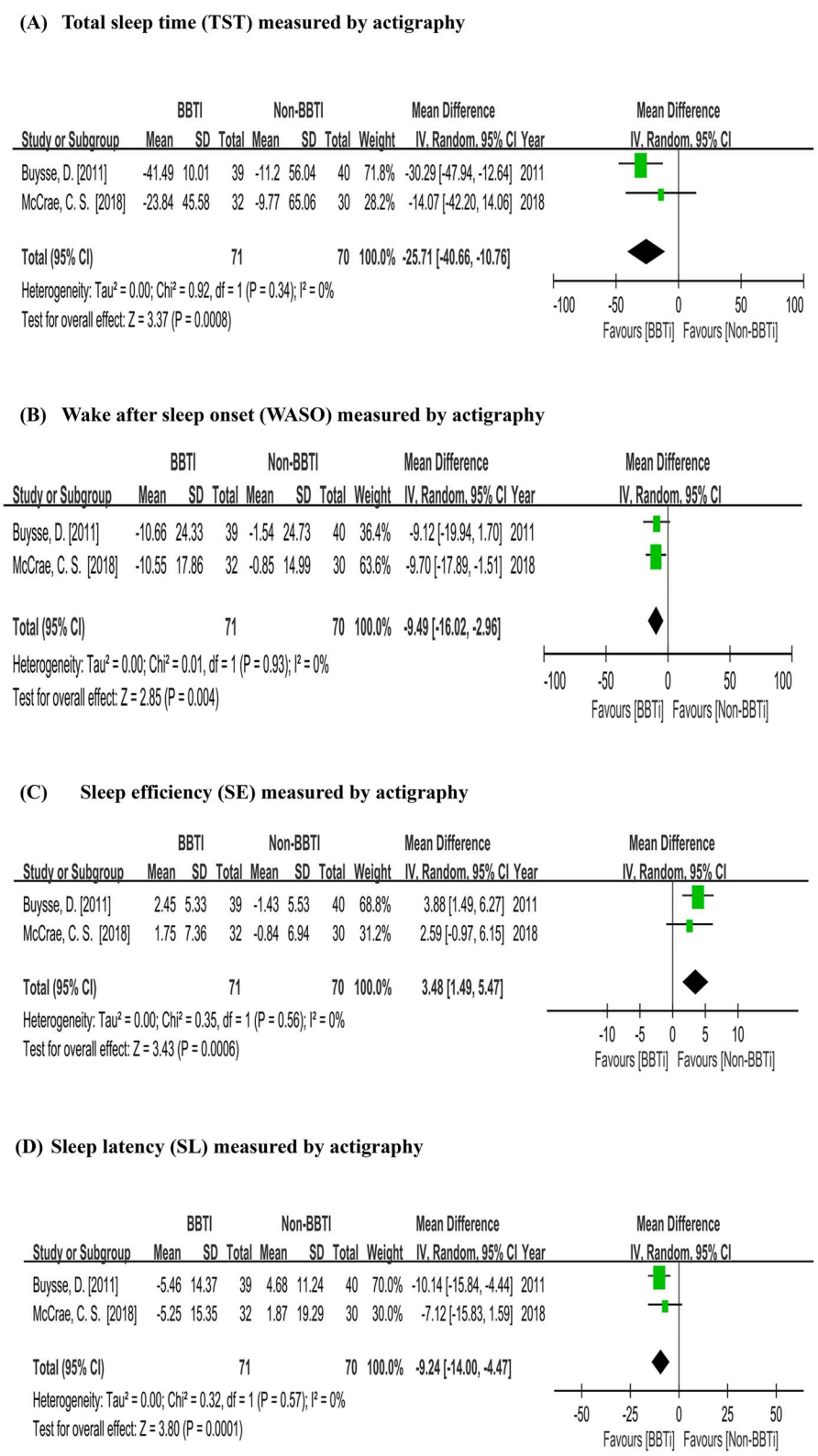
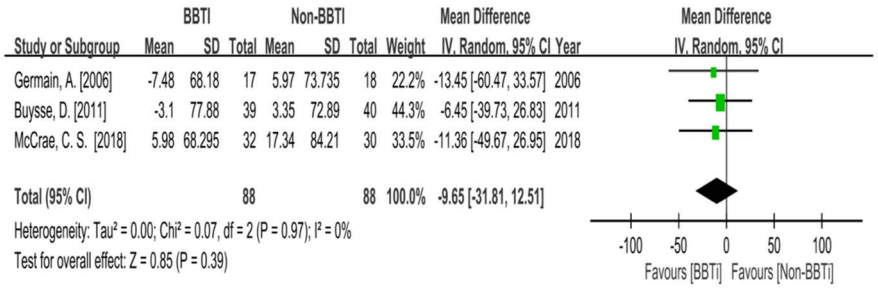
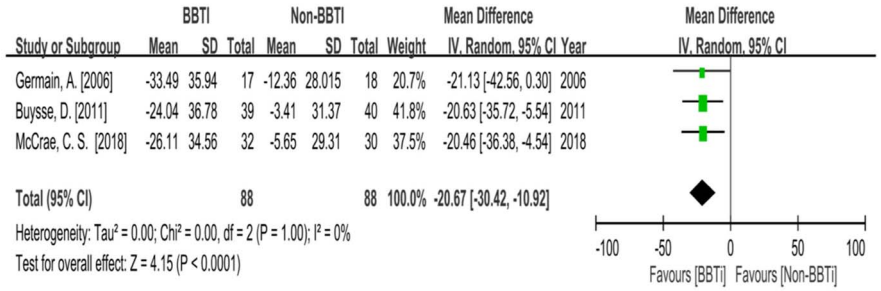


Figure 3. Mean difference in the efficacy of 4-week BBTi therapy on objective sleep parameters, measured by actigraphy among older adults with chronic insomnia. (A) TST measured by actigraphy. (B) WASO measured by actigraphy. (C) SE measured by actigraphy. (D) SL measured by actigraphy. Note: SD, standard deviation; IV, inverse variance; CI, confidence interval; df, degrees of freedom; Chi^2, chi-squared statistic; P, P value; I^2, I-squared heterogeneity statistic; Z, Z statistic.

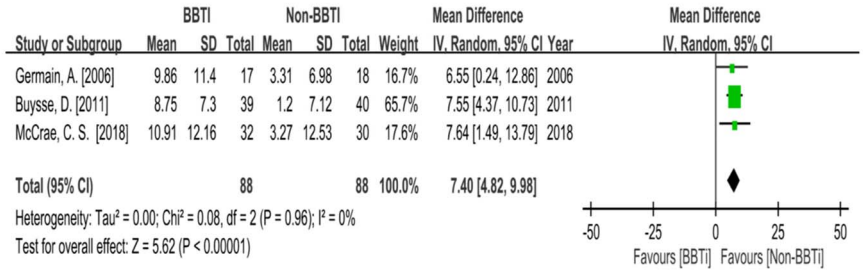
(A) Total sleep time (TST) measured by sleep diary



(B) Wake after sleep onset (WASO) measured by sleep diary



(C) Sleep efficacy (SE) measured by sleep diary



(D) Sleep latency (SL) measured by sleep diary

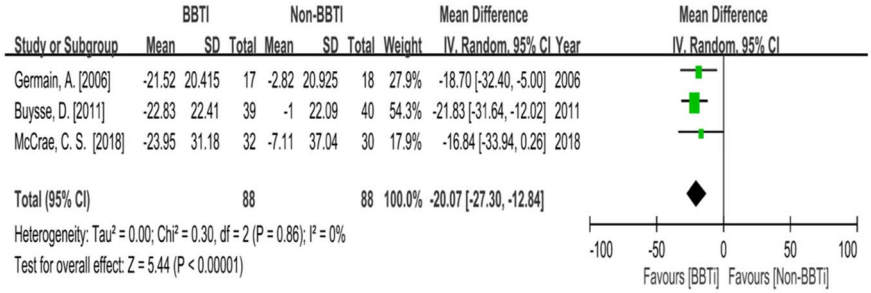


Figure 4. Mean difference in the efficacy of 4-week BBTi therapy on subjective sleep parameters, measured by sleep diary, among older adults with chronic insomnia. (A) TST measured by sleep diary. (B) WASO measured by sleep diary. (C) SE measured by sleep diary. (D) SOL measured by sleep diary. Note: SD, standard deviation; IV, inverse variance; CI, confidence interval; df, degrees of freedom; Chi^2, chi-squared statistic; *P*, *P* value; I^2, *I*-squared heterogeneity statistic; *Z*, *Z* statistic.

findings; the estimated TST between actigraphy-based and sleep diaries was slightly different. In particular, older adults with trouble falling asleep or waking too early most of the time were highly correlated with underreported sleep [34, 35]. Since older adults have chronic insomnia, it may have influenced self-reported estimates. Our study suggests that using objective measures such as actigraphy or polysomnographic testing for evaluating insomnia remission among older adults as an objective measure is warranted.

CBT-i is a type of nonpharmacological treatment for insomnia as well as the gold-standard intervention for treating insomnia. However, the potential difficulties with its use include adherence to the treatment protocol and attrition, which are highly associated with behavioural change. Not surprisingly, our study showed improvements in sleep quality and SE among older adults in cases of high adherence to BBTi therapy, ranging from 90.9% to 100%. This maintenance rate in our study was higher than that related to cognitive behavioural therapy within 8 weeks, ranging from 32% to 52% [36]. Similar findings obtained from a study of 696 veterans with insomnia revealed that subjects with high adherence exhibited significantly improved sleep quality compared with that in subjects with low adherence [37]. Continuous engagement in behavioural therapy and good levels of treatment adherence are key factors in achieving and sustaining sleep quality improvement, which is in turn essential for improving overall health and functioning, such as immune and cognitive functioning, in older adults [38, 39]. Efforts to provide short-term and simple BBTi would benefit from methods to improve treatment adherence and completion.

This study has some limitations. First, we included four studies with a high-performance bias, which may lead to overestimation effects in the meta-analysis. Second, given that only four RCTs were included, it is not possible to further investigate the possible factors related to the effects of the BBTi intervention. Finally, all studies included community-dwelling older adults with chronic insomnia; therefore, the sample was not representative of all older adults in different environments.

Conclusions

A 4-week BBTi intervention is a simple, efficacious and durable strategy for treating chronic insomnia in older adults. The results from this meta-analysis reveal that an individual-based BBTi intervention is more efficient in improving insomnia symptoms. In addition, it is easy to administer by nurses or healthcare workers. BBTi intervention may be the first-line nonpharmacological therapy to recommend to older adults with chronic insomnia, which could gradually reduce the demand for sedatives and sleeping medications.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Declaration of Conflicts of Interest: None.

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