Original Research

The effectiveness of cognitive behavioral therapy for insomnia in older adults: A rapid review

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ABSTRACT

Insomnia is a common sleep disorder encountered in older adults which causes many difficulties in daily life. Given safety concerns with sedative-hypnotic pharmacotherapy, behavioural treatments including Cognitive Behavioural Therapy for Insomnia (CBT-I) are preferred in the elderly. We have provided an updated, expanded evidence review of CBT-I in this population. A rapid review of randomized controlled trials evaluating CBT-I interventions in adults aged 60+ was conducted using a search of the databases PubMed and PsycINFO, returning 21 articles for analysis. Specific CBT-I interventions including individual, group, therapist-led, and self-guided formats were evaluated. Trials for novel formats including telehealth CBT-I were also assessed for subgroup analyses involving older adults. Quantitative (total sleep time, sleep efficiency, insomnia severity, etc.) and qualitative (participant feedback, etc.) outcomes were assessed. The research showed steadfast evidence for the effectiveness of CBT-I as the preferred intervention for insomnia disorders in the elderly. It also showed promising results for different delivery methods of CBT-I including self-help, group and virtual modes, which may help alleviate accessibility concerns to the service in the future. This represents a key area for further work to improve access to insomnia interventions in older adults.

Keywords: Insomnia, Cognitive Behavioural Therapy, Elderly, Older Adults

INTRODUCTION

Insomnia is a prevalent issue among older adults in today's society. Insomnia has been defined as difficulties with either the quantity or quality of sleep, which might include difficulties initially falling asleep, waking throughout the night, and more.[23] As of 2019, insomnia is experienced in up to 75% of older adults and has been documented as one of the most commonly experienced issues with sleep among this population.[23] Insomnia symptoms are estimated to be experienced by approximately 30 to 48% of older adults.[24] These are staggering numbers which also have a prominent economic impact on healthcare systems worldwide. The healthcare and productivity costs of insomnia symptoms in Canada in 2021 totaled $1.9 billion.[2] With these estimates, it is clear that insomnia warrants our attention as a society and that research on its associated impacts is critical to help alleviate such vast problems. Currently, the first-line recommendations for insomnia treatment consist of non-pharmacological treatments (NPTs) followed by treatment using medications only if NPTs fail.[17] The most widely used example of an NPT for insomnia, and the first-line treatment recommendation, is cognitive behavioural therapy for insomnia (CBT-I). This intervention is approximately 6-8 weeks long and consists of sleep restriction (concrete bed and awakening times), stimulus control (altering patient perspectives and experiences with their sleeping area), and reduction of hyperarousal.[11] Objective parameters of sleep quality such as total sleep time (TST) and sleep efficiency (SE) have shown improvement with CBT-I,[4] as well as subjective measure improvements via scales such as the Insomnia Severity Index (ISI) and Epworth Sleepiness Scale (ESS).[5] Of those studies examined, many noted that CBT-I and other NPTs are proven to be effective specifically in older adults diagnosed with insomnia.[3,8,13,17,19,28] However, medications such as benzodiazepines or non-benzodiazepine "Z-drugs" with faster action such as zolpidem can sometimes be prescribed more readily as an initial mode of treatment rather than CBT-I due to perceived convenience.[17] It has also been proposed that prescribing medications for insomnia may feel more within the physician's scope of practice than their perceived ability to educate patients about and refer them for CBT-I.[11] This represents a key area for further work to improve access to insomnia interventions in older adults.

Prior research in this area is limited. A systematic review published in 2003 examined the efficacy of CBT-I for older adults, but this study excluded participants with comorbid dementia or depression. A systematic review and meta-analysis on this topic has also been published which included 13 studies which were conducted between the years of 1993 to 2017.[8] Given these study time frames, more recent years of literature past 2017 have not yet been synthesized. While these comprehensive studies are important additions to the body of literature, there have been no studies to date on this subject in the novel form of a rapid review. This is a newer, alternative form of review which provides a more simplified summary of the existing literature, often with a particular focus on the most relevant or recent studies available. An updated rapid review in this area is particularly useful for

clinicians to reference to help inform their clinical knowledge and practice, especially in areas of healthcare that are constantly evolving. Overall, the purpose of this rapid review was to provide an updated, focused, evidence-based rapid review (the first of its kind) of CBT-I as a treatment for symptoms of insomnia in the elderly population over 60 years old.

METHODS

Selection Criteria

For this review, studies were included that applied CBT-I or a similar protocol as an intervention in the form of a randomized controlled trial. Several studies were found that did not use CBT-I specifically but used a very similar methodology (such as brief CBT-I, administered in fewer than 6-8 sessions), or had reported relevant outcomes. Randomized controlled trials were initially deemed most appropriate but the reviewers opted to include some comparable study forms with similar lengths, sample sizes, and established intervention and control groups. However, following a full-text review, only randomized controlled trials with clearly defined control groups were included. Only studies examining older adults with at least a mean age of 60 years or older were included; according to the United Nations, an older adult is defined as a person of age 60 or older.[32] Studies that were excluded did not meet the above criteria and were not written in English.

Data Sources and Searches

A search of the databases PubMed & PsycINFO returned 352 initial studies; 208 from PubMed and 144 from PsycINFO. Two reviewers participated in this process and worked independently. Search terms included "cognitive behavioural therapy", "insomnia", "older adult", "elderly", and relevant variations thereof. 94 duplicates were removed. Studies were assessed based on population, intervention used, control group characteristics, outcomes reported, and length of study. 194 studies were deemed irrelevant and excluded after the title and abstract screening. 43 studies were excluded following the full-text screening, leaving 21 remaining studies included in the final data collection, extraction and analysis (Figure 1). Reviewers preferred to include studies when uncertain of inclusion parameters to ensure that no relevant studies were excluded.

Data Extraction, Synthesis and Analysis

Data from all articles in agreement to include following the full-text review were extracted and organized into a structured table stratified into columns for year, participants, intervention, control, outcomes and results.

Upon review of the pertinent data from each of the papers, the results were grouped based on common characteristics and themes. The studies were classified based on the type of CBT-I involved; individual, group or combined CBT-I delivery; independent versus guided delivery; the presence or absence of telehealth in the delivery; the use of or withdrawal from sleep medications; and the inclusion of interventions other than CBT-I. The major themes of the studies were categorized into ideas such as:

a. Self-help versus professional-led CBT-I
b. The efficacy of individual, group and combined CBT-I
c. The implications of CBT-I conducted using telehealth
d. The efficacy of CBT-I versus sleep medications for insomnia relief
e. The impact of pre-existing sleep characteristics on the efficacy of CBT-I
f. The impact of comorbid health conditions on the treatment of insomnia with CBT-I
g. The effect of pre-existing beliefs about sleep on CBT-I treatment outcomes

These themes will be discussed in detail in the results section.

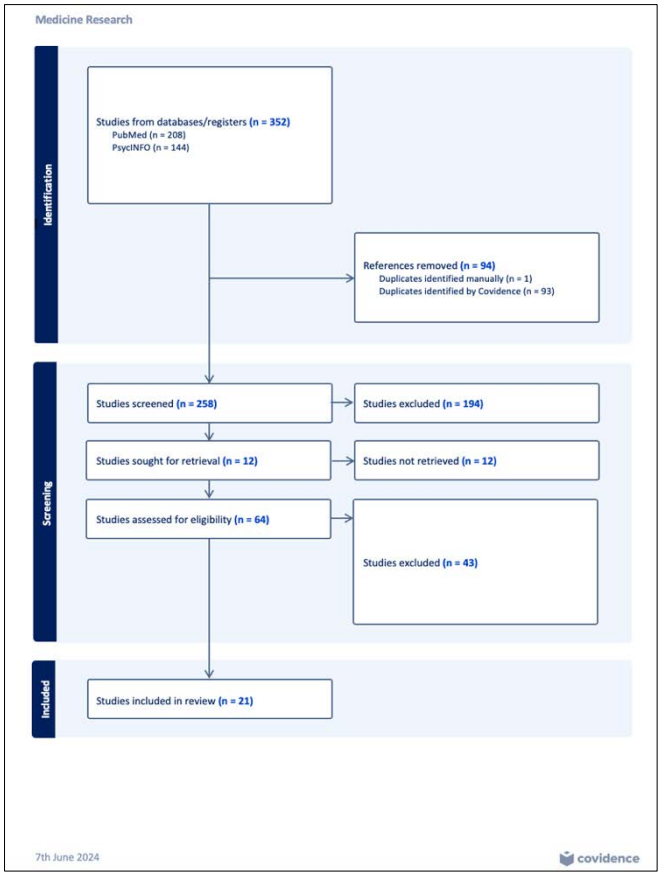

Figure 1. *PRISMA diagram.*

RESULTS

Descriptions of Included Studies

All 21 studies included and analyzed were randomized controlled trials. The sample sizes ranged from 14 to 327. Of the studies included, 19 used CBT-I manually led by a professional, 1 used a self-help intervention, 6 involved a telehealth intervention component, 3 involved a sleep medication intervention (1 with zopiclone; 2 with temazepam), 1 had a sleep medication withdrawal component, and 1 involved a Tai Chi intervention. 13 were individual interventions, 4 were group-based and 3 were a combination of both (see Appendix for details of included studies).

Description of Measured Outcomes

Efficacy of CBT-I versus Controls

20 studies found CBT-I significantly more effective than the control on at least one outcome measure (Figure 2). Only 1 study showed no statistically significant improvement in any outcomes measured (ISI, depression and anxiety ratings, quality of life ratings and use of sleep medications ratings) in the online delivery CBT-I group as compared to their control group in older adults with insomnia who were also experiencing bereavement.[7]

Self-help versus Professional-Led

Only 1 study used a self-help form of CBT-I with full independence bestowed upon participants.[20] According to this trial, 73% of participants surveyed indicated that they would recommend the self-help CBT-I intervention to others.[20]

Individual, Group-Based and Combined Delivery

Of the included studies, 14 used individual CBT-I.[1,6-7,10,12,14,18,20,25-27,29-30,34] 4 studies used group-based CBT-I.[9,15-16,33] 2 studies used a combination of individual and group CBT-I,[21-22] and 1 study offered a choice between the two modalities.[31] In the group-based studies, one study showed positive improvements in participants' scores on wakefulness after sleep onset (WASO-D), sleep efficiency (SE-D), ISI, Flinders Fatigue Scale (FFS), ESS, Daytime Feeling and Functioning Scale (DFFS), Sleep Anticipatory Anxiety Questionnaire (SAAQ), Dysfunctional Beliefs and Attitudes About Sleep Scale (DBAS) and Sleep Self-Efficacy Scale (SSES) compared to control.[15] Another group-based study found participants to have had significant positive improvements in sleep onset latency (SLAT), WASO, Short-Form McGill Pain Questionnaire (SF-MPQ) and SE scores.[33] A third group study found participants had positive impacts on their WASO and total sleep time (TST) scores in relation to the lessening of their insomnia symptoms.[16] Participants in a different group study also had improved positive findings regarding insomnia remission, sleep quality, sleep parameters, fatigue and depressive symptoms.

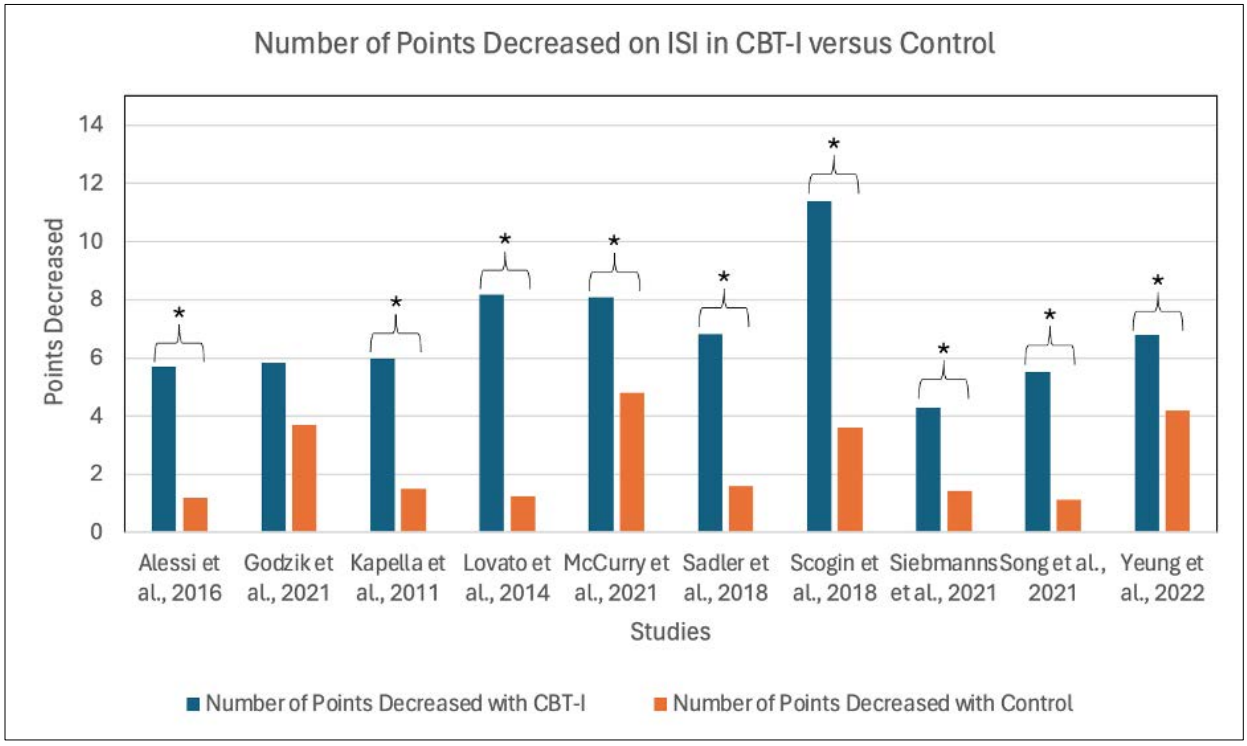

Figure 2. *The number of points decreased on ISI in CBT-I versus control conditions. Note: Asterisks indicate a statistically significant result ($p \leq 0.05$).*

Telehealth and CBT-I

6 studies included some form of telehealth.[7,18,20,26-27,34] Specifically, one study used a telephone delivery method for CBT-I in older adults with insomnia and comorbid osteoarthritis pain.[34] This study found that the use of telephone CBT-I specifically showed significant decreases in their older participants' ISI and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, both being positive outcomes for the purpose of the study. It was also noted that these improvements in symptoms came at no increased cost; thus, this study has implications for the cost-effectiveness of telehealth modes of CBT-I. In contrast, a study using an online-based CBT-I intervention found no significant improvements in insomnia symptoms relative to scores on ISI, depression and anxiety ratings, quality of life ratings and use of sleep medications ratings, as mentioned previously.[7] However, the authors noted that all participants completing the study had reported that they were able to complete every online learning module, which still holds promise for the feasibility of online forms of CBT-I for older adults.[7]

CBT-I versus Sleep Medications and Other Interventions

5 studies explored the efficacy of CBT-I compared to sleep medications or other interventions.[9.12,21,29-30] In one trial, when compared to the participants given zopiclone, the participants undergoing CBT-I showed significant improvements in sleep efficiency and time in slow-wave sleep.[29] Meanwhile, outcomes between those given zopiclone and those given a placebo medication did not significantly differ.[29] Another trial had an almost identical structure, except for having an additional group of participants given both CBT-I and sleep medication (temazepam), and all three of the interventions were found to show greater improvements in sleep outcomes than the placebo.[21]

In a study examining participants dependent on sleep medications, the sample was stratified into groups of either CBT-I treatment or a placebo control with the participants instructed not to change their usage of sleep medications.[30] Those who underwent CBT-I had better outcomes in sleep onset latency, wakefulness after sleep onset and sleep efficiency.[30] In contrast, another study used a sample of hypnotic-dependent older adults with insomnia and tested a withdrawal of sleep medications either alone (control), combined with placebo biofeedback or combined with CBT-I.[12] While all groups were successful in achieving a decrease in sleep medication usage, the only group that displayed significant improvements in sleep diary measures and sleep onset latency was the group treated with CBT-I.[12]

Besides sleep medications, other trials have been conducted which have compared CBT-I to interventions such as Tai Chi. In one randomized controlled trial, older participants with insomnia were assigned to receive either CBT-I, Tai Chi or sleep education as a control.[9] The CBT-I group was reported to have the highest incidence of clinician-determined insomnia remission.[9]

Pre-Existing Sleep Characteristics

In 2 studies exploring pre-existing sleep characteristics, short sleepers were defined as those who identified as objectively getting less than six hours of sleep per night, while normal sleepers were getting six hours of sleep per night or more.[15-16] In both studies, which employed CBT-I in older adults with insomnia, it was found that both short and long sleepers achieved similar statistically significant benefits with no major differences between the groups.[15-16]

Comorbid Health Conditions

2 studies explored the impact of CBT-I on insomnia comorbid with pulmonary issues.[6,10] In one study, participants who received CBT-I as compared to those who received a wellness education control protocol achieved greater statistically significant improvements in measures of insomnia severity, global sleep quality, wakefulness after sleep onset, sleep efficiency, fatigue, and beliefs and attitudes about sleep.[10] Similarly, in the other study examining older adults with occult sleep-disordered breathing, CBT-I significantly improved insomnia symptoms as compared to a sleep education control.[6] 3 studies reported that participants who received CBT-I for comorbid insomnia and osteoarthritis pain showed statistically significant improvements on measures of sleep quality and lessening of insomnia symptoms.[18,33-34] 1 study showed significant positive effects on ISI and Short-Form 12-Item Survey (SF-12) scores following treatment with nurse-led CBT-I as compared to an online self-study educational control condition for older adults with comorbid insomnia and cardiovascular disease.[27] Further, 3 studies explored the effectiveness of CBT-I in individuals with mood or emotional disturbances.[7,25-26] One study showed the effectiveness of CBT-I combined with CBT-D (cognitive behavioral therapy for depression) in participants with comorbid insomnia and depression.[26] In another study, two forms of CBT-I (CBT-I and CBT-I+, or advanced CBT-I with positive mood elements) showed significantly greater improvements in insomnia and depression symptoms when compared to a psychoeducation control group.[25] However, a study on elderly people with insomnia who had recently lost a loved one found no significant improvements with the employment of online-based CBT-I as compared to a psychoeducational control.[7]

Pre-Existing Beliefs About Sleep

5 studies explored CBT-I in the context of pre-existing beliefs about sleep.[10,14-15,22,31] In one study, it was found that decreased DBAS scores, or fewer dysfunctional views about sleep, was significantly associated with improvements in sleep efficiency.[22] Another study produced similar findings, where decreases in dysfunctional beliefs about sleep were associated with positive changes in sleep.[31] Conversely, 2 studies found that a trial of CBT-I showed decreases in DBAS

as a measurable outcome.[14,15] A further study also measured DBAS as a dependent variable following a six-week trial of CBT-I in older adults with comorbid insomnia and chronic obstructive pulmonary disease (COPD), but no significant improvements were found.[10]

DISCUSSION

Based on the existing literature, our findings show that CBT-I for insomnia treatment in the elderly is efficacious and carries significant benefits. This has helped contribute to and broaden the research available on this topic in the form of an updated, more focused rapid review following the systematic reviews conducted previously.[8,19] While these studies provide valuable insights, this rapid review has allowed for a more recent, relevant synthesis of the existing literature. The most recent year of publication of any of the studies included in the aforementioned reviews was 2017; the current review has provided an expansion upon these with the inclusion of 9 new studies published between 2018 and 2022. The alternative methodology of a rapid review has also allowed for the exploration of studies that assessed relevant outcomes but may have been excluded from a systematic review with more rigid inclusion and exclusion criteria. As an example, one of the inclusion criteria from the more recent systematic review specified that studies must have employed CBT-I alone; however, this rapid review has allowed for the inclusion of studies that employed CBT-I in combination with other interventions, such as CBT-D or pharmacotherapy.[8]

In 20 of the 21 randomized controlled trials examined, CBT-I was found to produce significantly greater beneficial effects on insomnia symptom severity than control conditions. This therefore serves as another study which adds to the breadth of existing research in support of the use of CBT-I for insomnia. The ideas highlighted in this study can also serve to identify ways in which CBT-I can be improved in its implementation, as well as in its accessibility in applications for various subgroups of older adults.

Regarding CBT-I versus sleep medications, one of the studies discussed suggested that CBT-I as a behavioral intervention is an improved, more sustainable method of insomnia relief than sleep medications.[29] This also highlights how even sleep medications alone may not offer any significant benefits for insomnia symptoms when compared to a placebo control group, which calls into question the efficacy of these medications alone. Another of the studies comparing CBT-I versus sleep medications also poses an argument for the effectiveness of CBT-I — particularly how its effects were better conserved over time in comparison to temazepam.[21] These findings warrant the need for further research comparing the efficacy of behavioral and pharmacological interventions in the treatment of CBT-I to guide future healthcare guidelines and recommendations for insomnia treatment. In the same vein, healthcare guidelines must also take into account those older adults who are currently dependent on sedative-hypnotic medications in their treatment of insomnia or other conditions. In one study, the effect of CBT-I on sleep medication usage was purposely not studied.[30] However, their findings may have implications for the effect of insomnia symptom improvement with CBT-I and the potential for sleep medication users to feel less dependent on hypnotic medications if their insomnia symptoms were to resolve. In one study, the authors did not observe any significant effect of CBT-I on medication tapering.[12] However, it did also show that CBT-I can be used as a powerful supplemental tool to harness greater relief of insomnia symptoms in this older, hypnotic-dependent population. This may serve as an area of research which could inform how CBT-I may be used as a tool in achieving remission of sleep medications in older adults who are dependent on them.

Other authors have proposed that Tai Chi (in addition to CBT-I) could be used as a tool in a stepped-care approach to insomnia relief, particularly due to its benefits on inflammatory markers that were also found in this trial.[9] Again, this has implications for resource allocation and cost reduction in insomnia treatment by potentially using less expensive forms of therapy before moving to a comprehensive CBT-I treatment protocol. This could even lessen the duration or intensity of CBT-I that any given patient may require following treatment with a less intensive therapy.

6 trials explored insomnia treatment in the context of chronic illnesses and CBT-I benefits have been upheld in sleep-disordered breathing,[6,10] osteoarthritis,[18,33-34] and cardiovascular disease.[27] This certainly puts forth the idea that CBT-I can be used as a tool in the complex web of treatment modes that older adults with chronic conditions require. As well, 3 studies explored CBT-I through the lens of comorbid depression in older adults.[7,25-26] 2 trials may posit that CBT-I is more effective for both insomnia and depression than CBT-D.[25-26] In one trial, despite a lack of improvement in the CBT-I group, the participants positively favoured the online form of CBT-I used.[7] The main drawback identified by participants regarding the content of the trial was that there was no bereavement-specific content.[7] This could have partially explained the lack of efficacy of the CBT-I treatment in this unique population experiencing bereavement, but not necessarily meeting the diagnostic criteria for depression. It may be that other forms of treatment and education are needed for a comprehensive treatment method for insomnia with bereavement specifically.

2 studies produced findings in favour of the reduction of dysfunctional sleep beliefs in the improvement of insomnia symptoms.[22,31] Both highlighted how in the treatment of insomnia, it is important to also focus on treating maladaptive attitudes about sleep which may serve as confounding preconceived beliefs in CBT-I treatment regimens. On the other hand, 2 studies found that following CBT-I treatment, dysfunctional sleep beliefs were shown to decrease.[14,15] Further research is needed in this area to investigate the bidirectional association between CBT-I and DBAS.

Regardless, it is still notable that DBAS requires further exploration in research concerning CBT-I. This also highlights the need for more research on CBT-I and DBAS, given that there are varied findings across different studies, with one study finding no significant changes in DBAS following CBT-I.[10]

Finally, 2 studies also found that regardless of one's usual duration of sleep per night, CBT-I treatment was still equally as beneficial in improving insomnia symptoms.[15-16] These findings highlight how CBT-I can be beneficial not only for those with the most severe insomnia symptoms but also for those who may already have some healthy sleep habits and are looking to improve other aspects of their sleep.

More research is needed in the area of CBT-I in a self-help, independently practiced form. The majority of studies examined focused on guided CBT-I, but if independent CBT-I is also comparatively efficacious, this could have major implications for making CBT-I more economical cost-wise.[20]

In studies which used a combination of individual and group CBT-I,[21-22] or included the option to do so,[31] it was not specified whether type had improved outcomes. More research is needed in this area to concretely identify whether individual versus group CBT-I is favoured and the factors that may influence these results.

As well, more studies will need to be conducted regarding the cost and resource usage of telehealth and virtual CBT-I in comparison to more traditional forms. Appropriately investigating older adults' capabilities in online CBT-I and their technological literacy could have major impacts on the cost of CBT-I delivery, as this could preserve resources such as rent for spaces to host sessions and hourly pay rates for employed professionals. One study was beneficial in outlining how the older adults were entirely able to use the online form of CBT-I employed, and viewed this in a positive light, despite the lack of results supporting relief of bereavement and insomnia symptoms with CBT-I.[7] It is also important to note the 5 studies which showed statistically significant improvements in insomnia symptoms in groups of older adults who underwent telehealth-delivered CBT-I without issue.[18,20,26-27,34]

Strengths and Limitations

This rapid review has a focused scope, which has allowed us to focus the review more practically on what is most relevant from a clinical standpoint for CBT-I research in older adults. This is of particular value for busy clinicians who may not be heavily involved or versed in academia but are looking to inform their practice and knowledge. As well, not all older individuals have the same opportunities and circumstances to be able to easily access CBT-I treatment. One area we focused on as part of our literature review results was the cost associated with CBT-I in its different forms. We have explored and discussed options for modifications to improve accessibility to CBT-I not only from a monetary standpoint, but in light of other barriers as well. For example, self-help, group-based and telehealth forms of CBT-I have been shown to be feasible options to increase the availability and accessibility of CBT-I for older adults in contrast to more traditional in-person, individual forms.

In terms of limitations — as a rapid review, this study is not as wholly comprehensive as a systematic review or meta-analysis which would discuss a much broader range of topics. A more focused scope also inherently produces a less extensive array of results and discussions than a larger systematic review would. All articles deemed relevant from our database searches were selected for review, though it may exclude some that would have been analyzed and included in a larger review. As well, more research is warranted in the vast majority of areas studied in the area of CBT-I and many gaps currently remain to be filled. For instance, virtual modes of CBT-I have largely become popularized only since the beginning of the COVID-19 pandemic in 2020. This has led to a number of new topics for study that have not yet been widely explored outside of the studies mentioned in this work.

CONCLUSION

CBT-I is the preferred method of treatment for insomnia in the elderly population. This is largely due to negative perceptions and concerns about side effects associated with pharmacological treatments, such as benzodiazepines. However, not all providers feel capable of educating and referring patients to obtain treatment. This has led to a discrepancy between the treatment recommendations and the actual prescribing patterns that are being practiced by healthcare providers. We have completed an updated analysis of the evidence-based efficacy of CBT-I for those aged 60 years and older via the results of 21 randomized controlled trials. This will help to inform best practices for insomnia treatment for this group of individuals and alleviate this discrepancy in what is recommended versus what treatments are actually given to patients. We also discussed options for making CBT-I more accessible for individuals at this age, with the aim of helping to ensure that all who wish to avail of it will have equitable opportunities to do so in the future. Virtual, self-help or group modes of delivery of CBT-I becoming more mainstream may ease the burden on the healthcare system, allowing more people to be treated effectively while using fewer resources. Currently, barriers such as provider shortages and financial constraints do not yet allow for this type of seamless access in many areas of the world. With more research and training in this area, CBT-I accessibility may be improved in years to come.

COMPETING INTERESTS

The authors declare there are no competing interests.

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APPENDIX

Table A1. *Study characteristics of included studies.*

Study Authors and Year of Publication	Participants	Intervention	Control	Outcomes	Results
Morgan et al., 2012	Adults aged 55 to 87 years (mean age 66.6 ± 7.43 years) with chronic diseases associated with chronic insomnia symptoms (N=193).	Self-help program consisting of six booklets provided at weekly intervals with advice on CBT-I, plus access to a telephone helpline.	A single sheet of advice regarding sleep hygiene.	Sleep quality. Primary outcome: PSQI. Secondary outcomes: ISI, SSEI, FSS.	Significant improvement on sleep outcomes in intervention group compared to control immediately post-treatment (PSQI - p<0.001; ISI – p<0.001; SE – p<0.001), at 3-month follow-up (PSQI – p-0.002; ISI – p=0.006; SE – p=0.001) and at 6-month follow-up (PSQI – p=0.003; ISI – p=0.003; SE – p=0.001).
Alessi et al., 2016	Community-dwelling veterans aged 60 and older (mean age 72.2 ± 7.7 years) meeting insomnia diagnostic criteria for 3 months or longer (N=139).	Five-session CBT-I delivered by non-clinician sleep coaches with masters' degrees including stimulus control, sleep restriction, sleep hygiene and cognitive therapy with weekly telephone behavioral sleep medicine supervision.	Five sessions of general sleep education.	Primary outcomes: SOL-D, WASO-D, TWT-D, SE-D, PSQI, objective sleep efficiency via wrist actigraphy. Secondary outcomes: ISI, depressive symptoms (PHQ-9) and quality of life (SF-12v2).	Significant improvement in SOL-D (p=0.02), TWT-D (p=0.004) and SE-D (p=0.005) in the intervention group compared to control group at 6-month follow-up (the primary outcome time point). Significant improvement in PSQI and ISI in intervention group compared to control group at post-treatment, 6-month follow-up and 12-month follow-up (all p<0.05).
Lovato et al., 2016	Adults with mean age 63.34 ± 6.41 years with sleep maintenance insomnia, stratified into short sleepers (<6 hours of sleep per night) and long sleepers (>/=6 hours of sleep per night) (N=91).	Four weeks of group-based CBT-I.	Waitlist.	One-week sleep diary, actigraphy, questionnaires (ISI, FFS, ESS, DFFS, DBAS, SSES, SAAQ).	Intervention group had significant improvements in WASO-D (p<0.001), SE-D (p<0.001) and TST (p<0.001), as well as significantly reduced scores on ISI (p<0.001), FFS (p=0.010), ESS (p=0.003), DFFS (p=0.003), SAAQ (p=0.006), DBAS (p<0.001), and significantly improved scores on the SSES (p=0.009) compared to control. No differences were observed between short and long sleepers.
Soeffing et al., 2008	Older adults aged 50 years or older (mean age 63.5 ± 8.7 years) with chronic insomnia and dependent on prescription sleep medications (N=47).	Eight-week individual CBT-I program consisting of relaxation training, stimulus control and sleep hygiene instructions.	Placebo group.	SOL, NWAK, WASO, TST, SE, SQR, SF-36.	Intervention group had significant improvements in SOL (p<0.05), WASO (p<0.05) and SE (p<0.05) compared to control.
Kapella et al., 2011	Adults with mild-severe COPD aged ≥45 years (mean age 63 ± 10 years) with self-reported sleep difficulties (N=14).	Six-week CBT-I provided by a nurse behavioral sleep medicine specialist consisting of stimulus control and sleep restriction.	Six-week wellness education (WE) program.	ITAS, SII, PSQI, ISI, sleep diary with actigraphy, DBAS, fatigue measures, anxious and depressed mood measured, perceived daytime function.	CBT-I group showed significant improvements in ISI (p=0.000), PSQI global sleep quality (p=0.002), WASO via sleep diary (p=0.030), SE via sleep diary and actiwatch (p=0.017; p=0.028), and beliefs and attitudes about sleep (p=0.000) compared to control. The control WE group showed significant improvements in depressed mood only (p=0.005).
Vitiello et al., 2009	Older adults (mean age 67.9 ± 8.23 years) with osteoarthritis and insomnia (N=51).	Eight-week group CBT-I program consisting of stimulus control, sleep restriction, cognitive restructuring, relaxation training and sleep hygiene education.	Attention-control (MSW) condition consisting of multi-component interventions for management of chronic pain (problem-solving, goal-setting, cognitive approaches to reducing stress and anxiety, interpersonal skills training, education about exercise enhancement).	Sleep log (SLAT, TST, WASO, SE), SF-MPQ, SF-36, GDS.	CBT-I group showed significant decreases in SLAT (p=0.014), WASO (p=0.000), and SF-MPQ (p=0.010), and increases in SE (p=0.000) post-treatment compared to control.
Sivertsen et al., 2022	Adults aged 55 years or older (mean age 60.8 ± 5.4 years) with insomnia (N=46).	Six weeks of CBT (consisting of sleep hygiene, sleep restriction, stimulus control, cognitive therapy and	Six weeks of placebo medication.	TWT, SOL, WASO, early morning awakening, TST, SE, slow-wave sleep.	CBT group experienced significantly improved outcomes on TWT compared to sleep medication and placebo (p<0.001), SE compared to placebo (p=0.004), slow-wave sleep compared to sleep medication and control (p=0.002; p=0.03), and TST over time (p=0.003).

		relaxation) or sleep medication (zopiclone).			
Scogin et al., 2018	Rural older adults aged 50 years or older (mean age 58.1 ± 5.62 years) with depressive and insomnia symptoms (N=40).	Integrated telehealth-delivered CBT-D (for depression) and CBT-I.	Continuation of usual care for depression and insomnia.	Primary outcome: ISI. Secondary outcomes: HAM-D, sleep diary (CSD - TIB, SOL, NWAK, WASO, TWAK, SQR, SE), formal assessment of depression and insomnia (SCID I).	Intervention group had improvements in ISI ($p<0.001$), SOL ($p=0.02$), SE ($p=0.02$), and SQR ($p=0.007$) compared to control.
Fung et al., 2016	Adults aged 60 years and older (mean age 72.2 ± 7.7 years) with insomnia and apnea-hypopnea index (AHI) < 15 (N=134).	Five sessions over six weeks of CBT-I provided by a health educator supervised by a sleep psychologist.	Sleep education control.	SOL, TWT, WASO, SE, PSQI.	Participants in CBT-I group with mild sleep-disordered breathing showed significant improvements in SOL ($p=0.0087$) and sleep quality via PSQI ($p=0.002$) compared to control at 6-month follow-up. The efficacy of CBT-I was similar for participants without sleep-disordered breathing.
Morin et al., 1999	Adults aged 55 years and older (mean age 65 ± 6.9 years) with insomnia (N=78).	Eight weekly individual and group sessions of CBT (consisting of stimulus control, sleep restriction, sleep hygiene and cognitive therapy), pharmacotherapy (temazepam), or a combination of both.	The same CBT protocol plus placebo medication.	Sleep diaries, polysomnography, SII.	The three active treatments showed significantly greater improvements than placebo control at post-treatment for WASO, SE, TWT and TST ($p<0.05$ for all), with the combination treatment showing the greatest improvements on all outcomes. Participants, participants' significant others, and clinicians rated behavioral treatment (either alone or combined with medication) as significantly more effective than medication alone ($p=0.01$) or placebo ($p=0.002$).
Lovato et al., 2021	Older adults (mean age 63.3 ± 6.4 years) with sleep-maintenance insomnia, classified as short sleepers (<6 hours) or normal sleepers (>/=6 hours) (N=91).	Four weeks of brief 60-minute group CBT-I.	Waitlist.	Sleep misestimation, sleep diary, actigraphy, SOL, WASO, TST.	Intervention group showed significantly improved WASO and TST immediately post-treatment and at 3-month follow-up compared to control (all p-values <0.01). There were no significant differences between those with either short or normal objective sleep duration before the trial.
Lichstein et al., 2013	Late middle-age and older adults with insomnia aged 50 years and older (mean age 63.4 ± 10.9 years) who were dependent on hypnotics (N=70).	Eight weeks of 45-minute CBT plus drug withdrawal, placebo biofeedback (PL) plus drug withdrawal.	Six biweekly 30-minute sessions of CBT combined with drug withdrawal via slow tapering (MED).	Polysomnography, sleep diaries, hypnotic consumption, daytime functioning questionnaires, drug screens.	Significant improvements in SOL ($p<0.05$) in the CBT group compared to control. Trended improvements in sleep diary measures and daytime functioning in all groups (not statistically significant; $p>0.05$). Significantly decreased hypnotic use in all groups from baseline to post-treatment ($p<0.05$).
McCurry et al., 2021	Older adults aged 60 years and older (mean age 70.2 ± 6.8 years) with insomnia and osteoarthritis pain symptoms (N=327).	Eight weeks of six 20-30 minute telephone-delivered CBT-I sessions.	Education-only group.	Primary outcome: ISI (2-months post-treatment and at 12-month follow-up). Secondary outcomes: pain (BPI-SF), depression (PHQ-8), fatigue (FFS).	2-month post-treatment ISI scores decreased significantly in the CBT-I group compared to EOC group ($p<0.001$); results were sustained at 12-month follow-up ($p<0.001$). At 12-month follow-up, 56.3% of participants receiving CBT-I remained in remission, compared to 25.8% of participants receiving EOC. Fatigue was significantly reduced in the CBT-I group compared to the EOC group at 2 months post-treatment ($p<0.001$) and 12-month follow-up ($p=0.003$). Post-treatment significant differences were found for pain on BPI-SF regarding severity & interference ($p=0.05$; $p=0.02$) but were not continued by 12-month follow-up ($p=0.75$; $p=0.45$).
Lovato et al., 2014	Older adults (mean age 63.76 ± 6.45 years) with sleep maintenance insomnia (N=118).	Four weeks of 60-minute CBT-I (consisting of bedtime restriction therapy, sleep education and cognitive restructuring).	Waitlist.	7-day sleep diaries, actigraphy, ISI, FFS, ESS, DFFS, SSES, SAAQ, DBAS.	Intervention group showed significant improvements in sleep timing and quality compared to control via reported WASO ($p<0.001$), SE ($p<0.001$), number of awakenings ($p=0.044$), subjective sleep timing ($p<0.001$), lights-out time ($p=0.001$), sleep onset time ($p=0.025$), out-of-bed time ($p<0.001$), and time in bed ($p<0.001$). The intervention group also had significantly reduced scores on ISI ($p<0.001$), FFS ($p=0.004$), ESS ($p=0.002$), DFFS ($p=0.001$), SAAQ ($p=0.003$), DBAAS ($p<0.001$), and improved scores on SSES ($p=0.001$) compared to control.
Irwin et al., 2014	Older adults aged	2-hour group sessions	2-hour group sessions	Primary outcome:	CBT group had significantly improved outcomes

	over 55 years (mean age 65.5 ± 9.7 years) with insomnia (N=123).	each week for 4 months of CBT or Tai Chi interventions.	each week for 4 months of sleep seminar education (SS).	Insomnia diagnosis by DSM-IV-TR criteria. Secondary outcomes: PSQI, AIS, sleep diary, fatigue (MDFSI), ESS, depressive symptoms (IDS-C), inflammation (C-reactive protein levels).	compared to both TCC and SS groups in insomnia remission (p<0.01), as well as for sleep quality, sleep parameters, fatigue and depressive symptoms (all p-values <0.01). TCC group also showed significant improvements in sleep quality, fatigue and depressive symptoms compared to SS group (all p-values <0.05).
Morin et al., 2002	Older adults (mean age 64.7 ± 6.9 years) with insomnia (N=72).	Eight weekly individual and group sessions of CBT (consisting of stimulus control, sleep restriction, sleep hygiene and cognitive therapy), pharmacotherapy (temazepam), or a combination of both.	The same CBT protocol plus placebo medication.	Sleep diary, polysomnography, DBAS.	CBT and combined groups showed greater improvements DBAS scores than placebo controls (all p-values <0.05). Post-treatment DBAS scores were significantly correlated with SE via sleep diary measures at 3-month, 12-month, and 24-month follow-ups (all p-values <0.05).
Yeung et al., 2022	Older adults aged 60 years and older (mean age 70 ± 7.1 years) with insomnia and osteoarthritis pain (N=325).	Eight weeks of treatment consisting of six telephone-delivered CBT-I sessions.	Education-only control.	Quality of life (QALYs), arthritis-specific quality of life (WOMAC), ISI, nights without clinical insomnia, intervention and healthcare utilization costs.	CBT-I group significantly improved in ISI and WOMAC measures compared to control (ISI – mean point difference of -2.6 (95% CI: -2.9 to -2.4; WOMAC – mean point difference of -2.6 (95% CI: -3.4 to -1.8). CBT-I had a 95% or greater probability of being cost-effective compared to control. No significant differences in quality of life measures were reported. **No p-values were reported in this study, which instead reported statistical significance in confidence intervals.*
Godzik et al., 2021	Older adults aged 55 years and older (mean age 65.39 ± 1.55 years) who experienced the death of a loved one within the past five years and reported insomnia symptoms (N=30).	Six weeks of online delivery CBT-I.	Attention control group using six weeks of online psychoeducational modules distinct from CBT-I content.	ISI, depression and anxiety (DASS-21), quality of life (WHO-QOL BREF), use of sleep medications (McNemar tests).	No significant differences reported on any outcome measures between groups (all p-values >0.05).
Song et al., 2021	Older veterans aged 60 years and older (mean age 72.2 ± 7.7 years) with insomnia (N=144).	Five weeks of weekly CBT-I manual-based sessions either individually or in small groups (consisting of sleep restriction, stimulus control, cognitive therapy, sleep hygiene, relaxation and relapse prevention).	Five weeks of manual-based, general sleep information only without directed guidance.	DBAS, actigraphy, SE, sleep diary, PSQI, ISI, ESS, FFS, severity of depression, health-related quality-of-life.	CBT-I group showed significant improvements in DBAS sleep expectation scores only compared to control (p<0.01). DBAS total score change was significantly associated with changes in PSQI, ISI, ESS, FFS, PHQ-9 and SF-12V2 (all p-values <0.05). CBT-I group had significantly stronger associations between reduced DBAS total score and improvements on PSQI, ISI, ESS, and FSS compared to control (all p-values <0.05).
Siebmanns et al., 2021	Patients with cardiovascular disease and insomnia (mean age 72.52 ± 9.81 years) (N=48).	Nine weeks of nurse-led CBT-I with support.	Nine weeks of Internet-based self-study program without support.	Primary outcome: ISI. Secondary outcome: SF-12.	CBT-I group showed significant improvement in ISI scores compared to control at post-treatment (p=0.004). The mean scores for SF-12 PCS and SF-12 MCS improved in both CBT-I and control groups, though not significantly between groups (p=0.14 and p=0.18, respectively).
Sadler et al., 2018	Older adults aged 65 years and older (mean age 75 ± 7 years) referred by a community mental health service who met the criteria for insomnia disorder and major depressive disorder (N=72).	Eight weeks of standard CBT-I or advanced CBT-I+ (added positive mood strategies).	Eight weeks of psychoeducation.	Primary outcomes: ISI, depression severity (GDS). Secondary outcomes: Sleep diary, SOL, WASO, TST, SE, sleep quality, DBAS, SLEEP-50 scale, anxiety (GAI-SF), depression (Beck Hopelessness Scale), quality of life (EQ-5D-3L).	CBT-I and CBT-I+ groups had significantly greater decreases in severity of insomnia and depression symptoms compared to control (p<0.001), sustained at 20-week follow-up.