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Geriatric Disorders (K Zdanys, Section Editor)

Recent Developments in the Management of Insomnia in Later Life

Caitlan A. Tighe, PhD[1,2]
Adam D. Bramoweth, PhD[1,3,*]

Address
[*,1]VISN 4 Mental Illness Research, Education and Clinical Center (MIRECC), VA Pittsburgh Healthcare System, Research Office Building (151R-U), University Drive C, Pittsburgh, PA, 15240, USA
Email: Adam.Bramoweth@va.gov
[2]Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA
[3]Center for Health Equity Research and Promotion (CHERP), VA Pittsburgh Healthcare System, Pittsburgh, PA, USA

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Abbreviation *ACP* American College of Physicians · *AASM* American Academy of Sleep Medicine · *BBTI* Brief behavioral treatment for insomnia · *CBT-I* Cognitive behavioral therapy for insomnia · *IC* Information control · *ISI* Insomnia Severity Index [57] · *MBSR* Mindfulness-based stress reduction · *MBTI* Mindfulness-based therapy for insomnia · *OTC* Over-the-counter · *PSQI* Pittsburgh Sleep Quality Index [58] · *RCT* Randomized controlled trial · *SE* Sleep efficiency · *SOL* Sleep onset latency · *TST* Total sleep time · *TWT* Total wake time · *WASO* Wake after sleep onset · *WL* Wait list

Abstract

Purpose of review Insomnia impacts a significant proportion of older adults yet is not an inevitable consequence of aging and is amenable to intervention. The aim of this narrative review is to provide an overview of recent recommendations and empirical findings regarding the management of insomnia in older adults.
Recent findings The treatment of insomnia with cognitive behavioral therapy for insomnia (CBT-I) continues to be empirically supported and the recommended first-line intervention for adults. Accumulating evidence indicates that other non-pharmacological therapies for insomnia, such as mindfulness-based therapies, light therapy, and physical activity interventions, as well as treatment delivered by non-clinician "sleep coaches" also positively impact insomnia symptoms. Finally, recent systematic reviews offer guidelines and recommendations for pharmacological management of insomnia.

Summary CBT-I remains the recommended first-line treatment for insomnia across adult ages. There is a continued need to increase the availability and optimize the delivery of CBT-I and other therapies for older adults with insomnia to maximize treatment benefits. There is also evidence for some benefit of pharmacological agents to treat insomnia; however, these are not without risks, particularly in the geriatric population.

Introduction

Insomnia disorder is defined as difficulty falling asleep, maintaining asleep, or non-restorative sleep with associated significant daytime impact and impairment of quality of life [1]. Chronic insomnia, insomnia disorder lasting longer than 3 months, is highly prevalent among adults, impacting anywhere from 5 to 10% [2], with higher prevalence rates estimated in older adults [3]. Notably, older adults tend to experience insomnia characterized by difficulties maintaining sleep [4••, 5, 6]. Despite known age-related changes in sleep (e.g., increased nighttime wakefulness, reduced duration of slow wave sleep), the increased prevalence of insomnia in older adulthood is not solely attributable to age [7, 8]. Rather, it may be more appropriately conceptualized as a consequence of interacting predisposing (e.g., age-related changes in sleep), precipitating (e.g., changes in physical health), and perpetuating factors (e.g., caregiving, bereavement) experienced in later life [9]. Insomnia, in turn, may adversely impact older adults' physical and psychological health, potentially leading to the development or persistence of conditions such as depression [10], pain [11], hypertension [12], and cognitive decline [13].

Fortunately, numerous evidence-based treatments have been developed, adapted, and refined over the past several decades that offer older adults and their providers several options for treatment. First and foremost are the psychological interventions, namely cognitive behavioral therapy for insomnia (CBT-I), which has the strongest evidence base and is the recommended first-line treatment. Though not the recommended first-line treatment, the most commonly used approach for most individuals with insomnia are the pharmacological agents with evidence of insomnia symptom reduction to varying degrees. Finally, additional non-pharmacological treatments such as exercise and light therapy have been investigated as treatment options for insomnia in older adults. A brief overview of treatment options and recent developments in the treatment of insomnia in later life is provided.

Psychological and behavioral treatments

Cognitive and behavioral therapies for insomnia

- Cognitive behavioral therapy for insomnia (CBT-I) is currently considered the first-line intervention for chronic insomnia in older adults [4••]. CBT-I typically involves 4 to 6 weekly or biweekly, 60-min, individual sessions. However, treatment modalities can vary and may include individual or group sessions, in-person, online, or telephone sessions, or self-management (see [14] for sample intervention details). CBT-I addresses maladaptive sleep-related behaviors

and cognitions that precipitate and/or perpetuate insomnia with the following components:

  - Psychoeducation
  - Stimulus control
  - Sleep restriction
  - Cognitive therapy techniques (e.g., cognitive restructuring, cognitive reappraisals)
  - Relaxation techniques
  - Sleep hygiene
- Brief behavioral treatment for insomnia (BBTI) is an additional multicomponent therapy for insomnia which differs from CBT-I in its shorter duration (two in-person and two telephone sessions over 4 weeks) and a focus solely on the behavioral components [15]. BBTI includes the following:

  - Psychoeducation
  - Stimulus control
  - Sleep restriction
- Finally, individual components of CBT-I and BBTI including stimulus control, sleep restriction, and cognitive therapy may be delivered independently, as single-component therapies [16].
- In a comprehensive review of psychological and behavioral interventions for insomnia [17••], CBT-I had a milder impact in older adults, as compared to younger or middle-aged adults, but still resulted in significant improvements in subjective global sleep quality and insomnia specific outcomes, as well as improvements on sleep diary measured sleep onset latency (SOL) of about 8 min, wake after sleep onset (WASO) of about 38 min, and sleep efficiency (SE) of about 10% when compared to inactive controls. Multicomponent behavioral therapies including BBTI also resulted in improvements in older adults' sleep diary measured SOL of about 10 min, WASO of about 15 min, SE of about 6%, and sleep quality compared to inactive controls [17••]. As a single-component therapy, stimulus control resulted in significantly improved total sleep time (TST) of about 40 min in older adults. There was insufficient evidence to draw definitive conclusions about the treatment effects of sleep restriction, relaxation, and cognitive therapy as single-component therapies in older adults.
- An updated literature search (since [17••]) yielded eight additional studies of cognitive and behavioral therapies for insomnia or sleep disturbance in late life, three of which were secondary analyses (see Table 1). All studies included older adults (≥ 55 years) who met diagnostic criteria for insomnia or had a sleep complaint. Five studies examined CBT-I: two compared CBT-I against sleep education, one compared CBT-I against a wait list control, and two evaluated CBT-I with no comparison groups. Of the remaining studies, one compared

Table 1. Cognitive and behavioral therapies for insomnia or sleep disturbance in later life published between 2015 and 2017

Authors, year	Sample	Study type	Study groups	Results
Cognitive behavioral therapy				
Alessi et al. 2016 [55]	159 veterans ≥ 60, with chronic insomnia	RCT	*Intervention*: CBT-I *Control*: sleep education	CBT-I vs. control had improved PSQI, ISI, and diary SOL, TWT, and SE, from baseline to post-treatment, 6-month, and 12-month follow-up; diary WASO declined from baseline to post-treatment.
Fung et al. 2016 [53]	134 adults ≥ 60, with insomnia with or without SDB	RCT, secondary analysis	*Intervention*: CBT-I *Control*: sleep education	Persons with insomnia + mild SDB who received CBT-I had improvements on PSQI and diary SOL vs. sleep education group; treatment benefit was similar for those with and without mild SDB.
Karlin et al. 2015 [59]	121 veterans ≥ 65 (657 veterans total), with insomnia	Non-RCT	*Intervention*: CBT-I *Control*: None	Significant ISI reductions across all ages; no significant differences between older and younger veterans' ISI change baseline to post-treatment.
Kay et al. 2015 [60]	63 adults > 60 with insomnia	Non-RCT, secondary analysis	*Intervention*: CBT-I *Control*: None	Post-treatment improvements in ISI, and actigraphy WASO, TST, SE, and diary SOL, WASO, and SE. Discrepancies between diary and actigraphy WASO and SOL were lower at post-treatment.
Lovato et al. 2016 [54]	91 adults (M_{age} = 63.34, SD = 6.41), with insomnia	RCT	*Intervention*: CBT-I *Control*: WL	CBT-I vs. control had improvements in ISI, actigraphy TST, and diary WASO and SE at post-treatment and 3-month follow-up. Treatment gains were similar at baseline for short (< 6 h) vs. long (≥ 6 h) sleepers.
Behavioral therapy				
Chan et al. 2017 [61]	62 older adults with chronic insomnia	RCT, secondary analysis	*Intervention*: BBTI *Control*: self-monitoring and attention control	BBTI vs. control had significant decreases in diary SOL variability and actigraphy TST variability. Decreases in bedtime variability, wake time variability, and TIB mediated reductions in sleep variability. Increased variability of baseline sleep behaviors was associated with greater BBTI benefit.
Other				
Martin et al. 2017 [56]	42 veterans ≥ 60, with sleep complaint	RCT	*Intervention*: sleep intervention program (SIP) *Control*: IC	SIP vs. IC had greater improvements in actigraphy SE, number of nighttime awakenings, and WASO at post-treatment and 4-month follow-up. SIP vs. IC had improvements in PSQI daytime dysfunction at 4-month follow-up.
Tamura et al. 2017 [62]	51 adults ≥ 60 with insomnia	Non-RCT	*Intervention*: sleep education, light exercise, goal-setting/ self-monitoring *Control*: WL	Intervention vs. wait list control demonstrated significant improvements in global PSQI, sleep diary WASO, SE, and actigraphy rise time, SOL, WASO, TST, and SE.

BBTI to a self-monitoring, attentional control group; one compared a sleep intervention program rooted in sleep compression and stimulus control to an information control group; and one compared a multicomponent treatment (sleep education, light exercise, goal-setting) to a wait list control. Although results of the studies differed due to varying outcome measures, CBT-I and BBTI tended to result in significant improvements in select subjective and behavioral sleep-wake parameters compared to education, attention, or wait list control groups.

Mindfulness-based interventions

- Considered a "third-wave" of cognitive behavioral therapy, mindfulness-based stress reduction (MBSR) is a psychoeducational and skills-based intervention designed to promote effective management of a range of physical and mental health symptoms, including insomnia, through the use of mindfulness and meditation practices [18, 19]. Typically delivered in a group setting over 8 weekly, 2.5- to 3.5-h sessions and 1-day-long retreat, MBSR intervention components include the following:

  - Psychoeducation
  - Instruction on formal and informal mindfulness meditation techniques
  - Daily independent practice of mindfulness
  - Silent retreat
- Derived from MBSR, mindfulness-based therapy for insomnia (MBTI) combines elements of MBSR and CBT-I [20, 21]. MBTI is delivered in a group setting, across 8 weekly 2-h sessions and a 1-day retreat. Treatment components include the following:

  - Psychoeducation about mindfulness and insomnia
  - Instruction on principles of mindfulness and formal mindfulness meditation practices
  - Stimulus control
  - Sleep restriction
  - Sleep hygiene
- Research on the effects of mindfulness meditation-based interventions for insomnia in adults (including but not limited to older adults) have produced mixed findings [18, 22–24].
- In an early review (2007) of the effects of MBSR on sleep disturbance in adults, four uncontrolled trials evidenced improvement in subjective measures of sleep duration or sleep quality, whereas three studies showed no significant treatment effects [18]. In a subsequent (2014) systematic review and meta-analysis, there was insufficient evidence of positive treatment effects of meditation interventions on sleep when compared to specific (e.g., pharmacologic) and non-specific (e.g., attention control) active control groups [22]. However, more recent reviews (2016, 2017) examining RCTs of mindfulness-based therapies for insomnia indicate

more favorable outcomes, characterized by significant treatment effects on select sleep parameters when compared to wait list, attention control, or sleep hygiene groups [23, 24].

Pharmacologic treatment

- Providers may refer to evidence-based resources including but not limited to the most recent evidence report from the American College of Physicians (ACP) [25], clinical practice guideline from the American Academy of Sleep Medicine (AASM) [26••], and the 2015 Beers Criteria [27••] as guides for prescribing medications for insomnia to older adults.
- It is currently recommended that pharmacological treatment be considered for individuals who do not experience symptom relief or resolution following a course of CBT-I [4••].
- When considering pharmacologic options for treating insomnia in older adults, providers should remain cognizant of the risk to benefit ratio of various medications and, more specifically, how this may be impacted by age-related changes in biopsychosocial functioning.
- It is recommended that medications for insomnia are used on a short-term basis, preferably not for longer than 4 to 5 weeks [4••]. If pharmacologic treatment is pursued, medications should be prescribed at the lowest effective dose. Providers are encouraged to apply a shared decision-making approach to discussing pharmacologic treatment options with their patients [4••].
- An overview of specific pharmacologic treatments for insomnia in older adults is presented. Medications are included if a recommendation for use is addressed in the current AASM clinical practice guideline, where recommendations are made as compared to no treatment [25]. Information on additional medications commonly used to treat insomnia but not included in the clinical practice guideline is also provided. When possible, recommended dosages are drawn directly from the ACP evidence report [24] and indications are drawn from both the ACP evidence report [24] and the AASM clinical practice guideline [25].

Non-benzodiazepine "Z" drugs

On the basis of moderate quality evidence, the current Beers Criteria [27••] strongly recommends avoiding use of non-benzodiazepine, benzodiazepine receptor agonist (BzRA) hypnotics (including eszopiclone, zaleplon, and zolpidem), due to the risk of adverse events in older adults (e.g., delirium falls, emergency hospitalization) and minimal known benefit of this class of drug on sleep latency and duration.

Eszopiclone

Recommended dosage in older adults	<2 mg [25]
Indications	Sleep onset or maintenance insomnia [25]
Contraindications	Hypersensitivity to eszopiclone [28, 29]
Main drug interactions	

	CNS-active drugs including ethanol and olanzapine; drugs that inhibit or induce CYP3A4 including rifampicin and ketoconazole [29]
Main side effects	Occurred at an incidence rate of ≥ 2%: unpleasant taste, headache, somnolence, respiratory infection, dizziness, dry mouth, rash, anxiety, hallucinations, and viral infections [29]

Zaleplon

Recommended dosage in older adults	5 mg [25]
Indications	Sleep onset insomnia, short-term use [25, 26••]
Contraindications	Hypersensitivity to zaleplon or any product component ingredients [28, 29]
Main drug interactions	CNS-active drugs including ethanol, imipramine, paroxetine, thioridazine, venlafaxine, and promethazine; drugs that induce CYP3A4 including rifampin; drugs that inhibit CYP3A4; drugs that inhibit aldehyde oxidase including diphenhydramine; drugs that inhibit both aldehyde oxidase and CYP3A4; drugs highly bound to plasma protein; drugs with a narrow therapeutic index including digoxin and warfarin; drugs that alter renal excretion including ibuprofen [29]
Main side effects	Neurologic symptoms including dizziness, headache, drowsiness, lightheadedness, difficulty with coordination, and "pins and needles" sensation on skin [28, 29]

Zolpidem

Recommended dosage in older adults	5 mg [25]
Indications	Sleep onset and maintenance insomnia, short-term use [25, 26]
Contraindications	Hypersensitivity to zolpidem [28, 29]
Main drug interactions	CNS-active drugs including imipramine, chlorpromazine, haloperidol, alcohol, sertraline, and fluoxetine; drugs that affect drug metabolism via cytochrome P450 including CYP3A4 inducers and inhibitors [29]
Main side effects	Short term: drowsiness, dizziness, and diarrhea. Long term: dizziness and drugged feelings [29]
Special points	Additional zolpidem compounds include zolpidem extended release (recommended dose of 6.25 mg for short-term use for sleep onset insomnia); zolpidem sublingual (Edluar™; recommended dose of 5 mg for short-term use for sleep onset insomnia); zolpidem sublingual (Intermezzo®; recommended dose of 1.75 mg, as needed, to reduce latency to reinitiate sleep after nighttime awakenings, if ≥ 4 h before planned wake time) [25]

Orexin receptor antagonists

Suvorexant

Recommended dosage for older adults	Lowest effective dose advised (adult recommended dosages: 10 mg; maximum 20 mg) [25]
Indications	Sleep onset [25] or maintenance insomnia [25, 26]
Contraindications	Narcolepsy [28]

Main drug interactions	CNS-active agents; CYP3A inhibitors; CYP3A inducers; digoxin [29]
Main side effects	Occurred in ≥ 5% and at least twice the rate as with placebo: somnolence [29]

Melatonin receptor agonists

Ramelteon

Recommended dosage for older adults	8 mg [25]
Indications	Sleep onset insomnia [25, 26••]
Contraindications	History of angioedema while taking ramelteon; use of fluvoxamine [28, 29]
Main drug interactions	Fluvoxamine; rifampin; ketoconazole; fluconazole; donepezil; doxepin; alcohol [29]
Main side effects	Occurred in ≥ 3% and more frequently than in those treated with placebo: somnolence, dizziness, fatigue, nausea, and exacerbated insomnia [29]

Antidepressants

On the basis of high-quality evidence, the current Beers Criteria [26••] strongly recommends that antidepressants with high anticholinergic and sedating effects and risk of orthostatic hypotension be avoided. However, consistent with sequencing recommendations for medication trials outlined in the Journal of Clinical Sleep Medicine 2008 Clinical Guideline for the Management of Insomnia [30], select sedating antidepressants are commonly used in limited doses or as alternatives to medications considered to be higher risk (e.g., benzodiazepines and BzRAs).

Doxepin

Recommended dosage for older adults	3 mg, 6 mg maximum [25]
Indications	Sleep maintenance insomnia [25, 26••]
Contraindications	Hypersensitivity to doxepin hydrochloride, component ingredients, or dibenoxepines; current or recent (past 2 weeks) use of monoamine oxidase inhibitors (MAOIs); untreated narrow angle glaucoma or severe urinary retention [28, 29]
Main drug interactions	MAOIs; cimetidine; alcohol; CNS depressants and sedating antihistamines; tolazamide [29]
Main side effects	Reported in ≥ 2% and more frequently than in those treated with placebo: somnolence/sedation, nausea, upper respiratory tract infection [29]
Special points	On the basis of high-quality evidence, the current Beers Criteria [27••] strongly recommends that Doxepin > 6 mg/day be avoided due to high anticholinergic and sedating effects and risk of orthostatic hypotension

Mirtazapine

Recommended dosage for older adults	7.5–15 mg (slower upward titration recommended for older adults) [31]
Indications	Major depressive disorder [29]; "off-label" use for management of Insomnia [31, 32]

Contraindications	Hypersensitivity to mirtazapine or any component ingredients; current or recent (past 2 weeks) use of MAOIs and other drugs that affect the serotonergic neurotransmitter systems [29]
Main drug interactions	MAOIs; serotonergic drugs; drugs affecting hepatic metabolism; drugs that are metabolized by and/or inhibit cytochrome P450 enzymes [29]
Main side effects	Reported in ≥ 5% and more frequently than in those treated with placebo: somnolence, increased appetite, weight gain, dizziness [29]
Special points	Mirtazapine is not currently approved by the FDA for the treatment of insomnia and current ACP guidelines indicate evidence for the use of antidepressants is insufficient or of low strength [25]. Due to the greater likelihood of renal impairment in older adulthood and risk of decreased clearance of mirtazapine in individuals with impaired renal functioning, particular caution is advised in dose selection for older adults [29]. Antidepressants may increase the risk of suicidal thoughts and behaviors.

Trazodone

Recommended dosage for older adults	Usual dose for depression in older adults: 75–150 mg; usual dose for insomnia in adults (not older adults specifically): 50–100 mg [33]
Indications	Major depressive disorder [29]; "off-label" use for management of insomnia [29, 33]
Contraindications	Hypersensitivity to trazodone or any component ingredients; current or recent (past 2 weeks) use of MAOIs; linezolid or intravenous methylene blue [33]
Main drug interactions	CNS depressants; CP3A4 inhibitors or inducers; digoxin or phenytoin; warfarin [29]
Main side effects	Reported in ≥ 5% and more frequently than in those treated with placebo: somnolence/sedation, dizziness, constipation, blurred vision [29]
Special points	Trazodone is not currently approved by the FDA for the treatment of insomnia. Current AASM guidelines indicate insufficient evidence to ascertain the efficacy of trazodone in the management of chronic insomnia and recommend against its use in the treatment of sleep onset or maintenance insomnia (versus no treatment) [26••]. Geriatric patients may be at increased risk of hyponatremia, an adverse reaction documented in association with antidepressant use [29]. Antidepressants may increase the risk of suicidal thoughts and behaviors.

Benzodiazepines

On the basis of moderate quality evidence, the current Beers Criteria [27••] strongly recommends that use of benzodiazepines be avoided in older adults due to increased sensitivity and decreased metabolism of long-acting agents. Further, benzodiazepines put older adults at an increased risk for cognitive impairment, delirium, falls, fractures, and motor vehicle accidents [27••]. ACP guidelines indicate insufficient evidence to ascertain the benefits of benzodiazepines for the treatment of insomnia in older adults [4••].

Temazepam

Recommended dosage for older adults	7.5 mg [25]
Indications	Sleep onset and maintenance (nocturnal and/or early morning awakenings) insomnia, short-term use [25, 26••]
Contraindications	Hypersensitivity to temazepam or other benzodiazepines; contraindicated in women who are pregnant or may become pregnant [29]
Main benzodiazepine drug interactions	Drugs and foods affecting hepatic microsomal enzymes; anticoagulants; antihistamines; anti-infective agents; cardiovascular agents; CNS agents; cyclosporine; dextromethorphan; disulfiram; ergot alkaloids; GI drugs; grapefruit juice; hormonal contraceptives; levodopa; probenecid; scopolamine; cigarette smoking [34]
Main side effects	Reported in ≥ 1%: drowsiness; headache; fatigue; nervousness; lethargy; dizziness; nausea; hangover; anxiety; depression; dry mouth; diarrhea; abdominal discomfort; euphoria; weakness; confusion; blurred vision; nightmares; vertigo (reported in ≥ 1%) [29]

Triazolam

Recommended dosage for older adults	0.125–0.25 mg [25]
Indications	Sleep onset insomnia, short-term use [25, 26••]
Contraindications	Hypersensitivity to triazolam or other benzodiazepines; contraindicated in women who are pregnant or may become pregnant; medications that impair the oxidative metabolism mediated by P4503A (CYP3A) [28, 29]
Main drug interactions	Opioids; drugs that inhibit triazolam metabolism via cytochrome P4503A; drugs and other substances demonstrated to be CYP3A inhibitors; drugs that affect triazolam pharmacokinetics by other mechanisms including ranitidine [29]
Main side effects	Drowsiness; headache; dizziness; light headedness; "pins and needles" sensations on skin; coordination difficulties [29]

Over-the-counter medications

- The AASM clinical practice guidelines advise against the use of diphenhydramine, tryptophan, melatonin, and valerian for sleep onset or maintenance insomnia in adults [26••]. There is a paucity of randomized controlled trials specifically and systematically assessing the efficacy, benefits, and risks of harm of over-the-counter (OTC) medications in older adults [35].
- Current evidence on the efficacy of L-tryptophan (250 mg) was classified as "high quality," with indication that the harms of this treatment outweigh the potential benefits [26••].
- Current evidence on the efficacy of diphenhydramine (50 mg) was classified as "low quality," with an indication that the benefits of these treatments are approximately equal to the harms in adults [26••]. However, based on moderate quality evidence of its anticholinergic effects, the current Beers Criteria [27••] strongly advises that diphenhydramine be avoided in older adults.

- Current evidence on the efficacy of melatonin (2 mg) was classified as "low quality," with the benefits of this treatment presumed to be approximately equal to the potential harms [26••].
- Current evidence on the efficacy of valerian and valerian-hops combinations (variable doses) was classified as "low quality," with indication that the benefit of this treatment is approximately equal to the potential harm [26••].

Exercise and physical activity

- Physical activity is proposed to influence sleep through multiple pathways which include but are not limited to antidepressant and anxiolytic effects, thermoregulation, body restoration, energy conservation, circadian phase-shifting, and immune functioning [36–38]
- Recent reviews [37, 39] corroborate the beneficial effects of physical activity on select sleep parameters suggested in earlier studies (e.g., [36, 40]). Yang and colleagues [39] reviewed six RCTs on the impact of physical activity on sleep in middle-aged and older adults. Interventions primarily involved moderate aerobic exercise resistance training occurring over the course of 10 to 16 weeks. Target duration and frequency of exercise ranged from 10 to 60 min, three to five times per week. Compared to individuals assigned to non-exercise or health education control groups, those who participated in exercise interventions demonstrated moderate improvements in PSQI-assessed global sleep quality, sleep latency, and sleep medication use. There were no statistically significant differences on PSQI-assessed sleep duration, sleep efficiency, or sleep disturbance. In a single trial examining polysomnography-assessed sleep outcomes, exercise training resulted in a lower percentage of time spent in stage 1 sleep and a higher percentage of time spent in stage 2 sleep.
- Since the review by Yang et al. [39], several studies have supported the benefits of light to moderate physical activity interventions on older adults' subjective sleep [41, 42]. One shorter (8 week) physical and social activity intervention in older nursing home residents with subjective or observed sleep difficulties evidenced significant reductions in subjective insomnia severity compared to an untreated control group [41]. Results from a longer (52+ week) moderate-intensity physical activity intervention, compared to a health education group, found a preventative rather than a treatment effect [42]. The sample was sedentary, community-dwelling older adults, roughly a third of whom had ISI scores ≥ 8 and half had PSQI scores > 5. Participants in the physical activity group were less likely to develop poor sleep quality (i.e., PSQI > 5) over the study period. However, at the follow-up assessment, there were no group differences for reductions of sleep quality (PSQI) or insomnia severity (ISI).
- Though methodological limitations preclude definitive conclusions about their clinical utility, reviews of meditative movement interventions (e.g.,

tai chi, qi gong, yoga) suggest potential positive effects on older adults' subjective sleep quality [39, 43].
- There is a continued need for research on the types (e.g., aerobic, resistance, yoga) and characteristics (e.g., timing, duration) of physical activity required to improve sleep, the mechanisms through which physical activity impacts sleep, and factors that influence the strength of the beneficial effects of physical activity on sleep, alone and compared to other interventions.

Other treatments

- A recent systematic review and meta-analysis of 53 intervention studies supports the utility of light therapy in the management of a range of sleep problems, including insomnia, in adults (M_{age} 15–86.9 years) [44]. With the exception of early morning awakenings, small to medium treatment effects were observed across sleep outcomes and ages. Despite several reviews [44–46], there is a lack of currently published clinical standards or guidelines for the treatment of insomnia with light therapy in older adults.
- Based on a meta-analysis of five randomized and quasi-randomized controlled trials, moderate-quality evidence suggests that adults with insomnia (aged 19 to 83 years) who engaged in music interventions experienced significant improvements in global sleep quality compared to groups who received no treatment or treatment as usual [47]. Interventions varied, but required participants to listen to pre-recorded music anywhere from 25 to 60 min/day for 3 to 35 days.
- Based on a systematic review and meta-analysis of 30 RCTs, individuals with insomnia (aged 17 to 75 years) who received acupuncture were found to experience significantly greater improvements in global sleep quality relative to sham/placebo, as well as pharmacotherapy (BzRA) groups [48]. Number of acupuncture sessions ranged from 4 to 30 and treatment duration ranged from 10 days to 6 weeks. Notably, the magnitude of treatment effects was small and the bias and heterogeneity of the reviewed studies were significant, preventing definitive inferences about the effectiveness of acupuncture for insomnia. Current ACP guidelines similarly note insufficient evidence to support the efficacy of complementary and alternative treatment approaches, defined as acupuncture and Chinese herbal medicine, for the treatment of insomnia in older adults [4••].

Conclusion

In the context of older adulthood, insomnia is increasingly recognized as a multifactorial syndrome [9, 49, 50], thus prompting evaluation and treatment as such. CBT-I is currently the recommended first line of treatment for insomnia across adult ages. Recent work continues to support its efficacy in alleviating insomnia symptoms [17] and effectiveness in a range of populations, including individuals with medical and/or psychiatric comorbidities [51–53] and varying

sleep profiles (e.g., long versus short sleepers) [4]. In recent years, there have been increased efforts to disseminate and implement CBT-I and other behavioral sleep medicine practices for the treatment of insomnia. Both Alessi and colleagues [55] and Martin et al. [56] contributed to this work by demonstrating that CBT-I delivered to older adults by non-clinician health educators produces favorable outcomes. Should CBT-I fail to alleviate symptoms of chronic insomnia, current clinical guidelines recommend that providers discuss with patients the potential costs and benefits of pharmacological options to inform a decision to initiate short-term pharmacological therapy [4••]. Providers should refer to the appropriate clinical guidelines and recommendations [26••, 27••] for pharmacological therapies in older adults to ensure safety. Finally, although not currently endorsed as first-line treatment approaches, psychological therapies rooted in mindfulness meditation, as well as therapies involving bright light exposure or physical activity, show promise in the treatment of insomnia in older adulthood.

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Compliance with ethical standards

Conflict of interest

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Caitlan A. Tighe declares that she has no conflict of interest.

Human and animal rights and informed consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

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