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Optimizing Sleep in Older Adults: Treating Insomnia

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Abstract

As the world's population ages, the elevated prevalence of insomnia in older adults is a growing concern. Insomnia is characterized by difficulty falling or remaining asleep, or by non-restorative sleep, and resultant daytime dysfunction. In addition to being at elevated risk for primary insomnia, older adults are at greater risk for comorbid insomnia, which results from, or occurs in conjunction with another medical or psychiatric condition. In this review, we discuss normal changes in sleep that accompany aging, circadian rhythm changes and other factors that can contribute to late-life insomnia, useful tools for the assessment of insomnia and related problems in older people, and both non-pharmacological and pharmacological strategies for the management of insomnia and optimization of sleep in later life.

Keywords

aging; primary insomnia; comorbid insomnia; treatment

1.1. Introduction

The world's population of older adults is growing. In the past 50 years, the number of older adults has tripled, and it will triple again by 2050 [1]. Sleep complaints are prevalent among older adults, with over 50% reporting difficulty initiating or maintaining sleep [2]. Findings suggest that sleep complaints in older adults are due to multiple factors, including changes in circadian rhythms [3], an age-related increase in the prevalence of chronic medical conditions [4, 5], and psychosocial changes that commonly accompany aging [6, 7]. In addition to having an elevated prevalence of sleep complaints, older adults are more likely to have clinical levels of these complaints, and to receive a diagnosis of insomnia [8]. As the population of older adults continues to grow, so too will the prevalence of insomnia and associated conditions, making assessment and treatment increasingly important. Here, we briefly review normal age-related changes in sleep, primary and comorbid insomnia, tools for the assessment of insomnia and related problems, and pharmacological and non-pharmacological treatments for optimizing sleep in later life.

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Age-Related Changes in Sleep and Circadian Rhythms

Sleep is currently classified into four stages, which are differentiated by their waveforms on the electroencephalogram (EEG) and by other physiological signals. The first three stages are non-rapid eye movement (NREM) 1, 2, and 3, and the fourth stage is rapid eye movement (REM) sleep [9]. NREM 1 is the lightest stage, and accounts for 18% of older adults' sleep time [10]. Sleep deepens in NREM 2, which accounts for 48% of sleep time, and deepens further in NREM 3, which accounts for 16% of an older individual's sleep time and is referred to as slow-wave sleep (SWS), due to its slow (0.05–2 HZ), high-amplitude EEG signal [10]. Finally, REM sleep is referred to as "paradoxical sleep" because brain wave activity is similar to that of a waking brain, but the body is paralyzed [11]. Most dreaming occurs during REM sleep, which accounts for 18% of sleep time among older adults [10]. Beginning in middle age, adults spend less time in SWS and REM sleep and exhibit decreases in total sleep time, but sleep efficiency (the proportion of time in bed spent sleeping) continues to decrease past age 60 [12].

In addition to changes in sleep, older adults commonly demonstrate changes in *circadian rhythms*, the physiological and behavioral processes that oscillate once approximately every 24 hours and are controlled by the suprachiasmatic nucleus (SCN) in the hypothalamus [13]. The sleep-wake cycle is one of these rhythms. The SCN responds to external cues, known as *zeitgebers*, such as light, which are central to synchronizing circadian rhythms to the environment [14]. Several physiological age-related changes are thought to produce alterations in circadian rhythms. For example, older adults exhibit decreases in the number and density of melatonin-, vasoactive intestinal polypeptide-, and vasopressin-expressing neurons in the SCN that may interfere with its normal function [13]. Deterioration of the SCN is believed to result in a reduction in the amplitude of core body temperature, a marker of circadian rhythms [15, 16]. In addition, it is common for older adults to go to bed and wake up at earlier times than younger people. This shift is known as a circadian phase advance, and may result from the physiological changes just described and from additional factors [3].

2.1. Insomnia: Definition and Contributing Factors

While over half of older adults report at least one sleep complaint, a smaller percentage of older adults meet clinical criteria for diagnosis of insomnia [2, 8]. Insomnia can be separated into two types: "primary" and "secondary" or "comorbid." As of 2005, however, the National Institute of Health (NIH) recommended that the term "comorbid insomnia" replace "secondary insomnia" to reflect the clinical challenge in defining whether insomnia is a symptom of a primary disorder, or a separate, comorbid disorder [8]. Insomnia that initially occurs secondary to a physical or psychiatric disorder may evolve into an independent problem that has a bidirectional relationship with the original primary disorder [17]. As insomnia symptoms persist, the likelihood that cognitive and behavioral adaptations play an increasing role in the perpetuations of symptoms is enhanced. Primary insomnia is characterized by trouble initiating or maintaining sleep, or by non-restful sleep that causes impaired daytime functioning, and is not attributable to a general medical condition, medication, another sleep disorder, or a mental disorder [18]. While the etiology of primary insomnia remains unclear, both physiological and psychological theories have been proposed, including: hyperarousal, heightened physiological stress responses, predisposing personality characteristics, attitudes towards and misconceptions about sleep, and maladaptive compensatory behaviors (e.g., extending time in bed) [8].

Comorbid insomnia is similar in clinical presentation to primary insomnia but results from primary sleep disorders, medical conditions, psychiatric disturbances, medication use, and psychosocial factors associated with aging (e.g., retirement, inactivity, or caregiving) [6, 7,

19]. Compared to younger people, older adults have higher rates of primary sleep disorders other than insomnia, such as obstructive sleep apnea (OSA), restless legs syndrome (RLS), and periodic limb movements (PLMs), which are risk factors for insomnia symptoms [20]. OSA affects 19% to 57% of older adults and is characterized by repeated cessation or attenuation of breathing ("apneas" and "hypopneas", respectively) during sleep [21]. The most common OSA symptoms are loud snoring or gasping during sleep and daytime sleepiness [22]. RLS is characterized by uncomfortable sensations in the legs, marked by the urge move one's legs, which are relieved by movement of the legs; these symptoms have a distinct circadian pattern (minimal in the morning and worse at night) making it difficult to sleep [20]. PLMs are involuntary limb jerks experienced by up to 45% of older adults, are frequently observed among individuals with RLS, and can disrupt the sleep of both affected individuals and their bed partners [23].

The bulk of insomnia symptoms in older adults may be attributable to the increased prevalence of chronic conditions in this population; only 1% to 7% of insomnia in later life occurs independently of chronic conditions [4, 5]. A study of older adults found that approximately 25% of respondents had four or more chronic conditions, and two-thirds of these reported sleep problems [5]. Chronic pain is frequently accompanied by insomnia in older adults [5]. Pain and sleep are interrelated; pain has been shown to disrupt sleep, but sleep deprivation can also result in a decreased pain threshold [24]. Osteoarthritis (OA) is often a source of pain in older adults, affecting more than 50% of those aged 65 and older [25]. The chronic course of OA is associated with chronic comorbid insomnia in older adults [26].

Chronic insomnia is also prevalent in older adults with mood disorders, and insomnia is among the diagnostic criteria for several psychiatric disorders [18]. Insomnia is particularly associated with depression and generalized anxiety disorder (GAD); between 40% and 60% of insomnia patients have depressive or GAD symptomatology [27]. Though insomnia can be a symptom of these disorders, it can also contribute to or exacerbate psychiatric disorders, and should be targeted for treatment when present [17].

Lifestyle changes common in old age, such as retirement, reduced mobility, and reduced social interaction are additional sources of sleep disruption [28–30]. Structured daily activities, such as work and scheduled social interactions, are thought to serve as zeitgebers [28]. It is common for older adults to become a caregiver for a family member with functional impairment—often a spouse. Caregivers, particularly those caring for a family member with dementia, have sleep patterns similar to individuals with depression or insomnia [31]. Sleep problems are more prevalent in women who are caregivers, and those experiencing greater caregiving-related distress, suggesting that caregiving may cause ruminations and anxiety while lying in bed [7, 32]. Among family caregivers of older adults with dementia, disturbed care recipient sleep and related nocturnal behavior problems are burdensome and commonly cited as the reason for nursing home placement [33, 34]. Recently, greater objectively measured sleep disturbance among a general population sample of older women was linked to a greater risk of functional decline and placement in a nursing or personal care home [35, 36], but the mechanisms underlying this association remain unclear.

Circadian phase advance in older adults can lead to less total time in bed, greater daytime sleepiness, and more daytime napping, which can further contribute to complaints about nighttime sleep [14, 15]. It has been hypothesized that age-related changes may occur downstream from the SCN (e.g., the age-related decline of behavioral and physiological rhythms may result in less effective periodic signals that are important for maintaining oscillation in peripheral tissues), and that, due to these downstream changes, circadian

signals are no longer transmitted with the same strength to the pacemaker [37, 38]. This results in a disrupted feedback loop, and leads to sleep complaints, and daytime sleepiness and napping [37, 38]. Further, age-related yellowing of the eye's lens may restrict light input to the SCN, and reductions in input from this signal can disrupt the sleep-wake cycle [39].

3.1. Assessment of Insomnia in Older Adults

Various self-report measures can be used to assess insomnia, including sleep diaries and questionnaires. To complete a sleep diary, the patient records their sleep patterns (e.g., times into and out of bed, number and length of nighttime awakenings), usually over a week or two, and the results are reviewed by a clinician [40]. Although there is no standard format for sleep diaries, an effort has been made to standardize them. In 2005 a group of insomnia experts developed a Consensus Sleep Diary that included items for sleep onset latency, wake after sleep onset, total sleep time, time in bed, sleep efficiency, and sleep satisfaction [40]. Although polysomnography is generally not indicated to assess insomnia, because older adults have higher rates of sleep disorders other than insomnia, clinician should carefully screen for signs and symptom of other sleep disorders and have a low threshold for referring older adults for a sleep study, especially if they do not adequately respond to treatment.

While sleep diaries are extremely useful for assessing sleep patterns and insomnia and are a core component of behavioral therapies for insomnia, they require that a patient take them home, complete them over a series of nights, and return them to a clinician with insomnia expertise for interpretation [40, 41]. There are several questionnaires, however, that are useful for rapid assessment of insomnia symptoms and related problems and can be completed during an office visit. Two of these are the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). The PSQI is a 19-item questionnaire that measures seven domains of the respondent's sleep over the prior month (i.e., sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, daytime dysfunction) and yields a global score, with higher scores indicating greater sleep disruption [42]. Global scores >5 are generally considered to be indicative of a clinically significant sleep disturbance [42], but it is unclear whether this cutoff is appropriate for older adults. A study in older men found that the PSQI has good internal consistency and validity; measures of internal consistency were improved when the items pertaining to daytime functioning and medication use were removed [43] and a study in older women came to many of the same conclusions [44].

While the PSQI is a useful tool for general assessment of sleep-related problems in older adults, the ISI was developed to specifically focus on the diagnostic criteria for insomnia in both the DSM-IV and ICSD [41, 18, 19]. The 7-item ISI measures the subjective symptoms and negative outcomes of insomnia over the past two weeks, and the worries and distress caused by these [41]. A score >7 on the ISI indicates "subthreshold" levels of insomnia; scores >14 indicate "clinical insomnia" [41]. Compared to sleep diaries, the ISI has good validity and high internal consistency middle-aged and older age insomnia patients, and has been shown to be sensitive to detect changes over time [41].

4.1. Interventions for Insomnia in Older Adults

Interventions for insomnia include behavioral and cognitive-behavioral therapy (CBT), lifestyle interventions, and pharmacotherapy; however the evidence supporting the effectiveness of these individual interventions varies [8, 26, 30, 32, 45, 46]. Behavioral therapies include sleep restriction and stimulus control interventions, as well as sleep hygiene and relaxation [47]. Sleep restriction involves reducing time in bed to the time an individual is actually able to sleep until sleep efficiency improves [48]. Next, time in bed is gradually increased until the patient is able to fill the desired time in bed with consolidated

sleep [48]. Alternatively, sleep compression involves gradual reductions in time spent in bed to the amount of time an individual is actually asleep, as compared to an immediate shift [49]. Stimulus control interventions aim to reassociate the bed and bedtime with sleep, and to reduce the arousal and frustration related to lying in bed unable to sleep. Stimulus control techniques include going to bed only when tired; using the bed only for sleep and sex; leaving the bed if unable to fall asleep within 15 to 20 minutes; and waking at a consistent time every morning [50]. Sleep hygiene education provides information on how exercise, diet, substances (caffeine, medications, alcohol, nicotine), and the environment (light, noise, heat) can affect sleep [51, 52], while relaxation training attempts to calm physiological arousal by instructing individuals to sequentially tense and relax muscles or instructs individuals to engage in guided imagery, diaphragmatic breathing, or meditation [32, 53, 54]. Cognitive therapy attempts to restructure negative or erroneous thoughts, ideas, and attitudes about sleep, and in older adults this involves educating persons about normal age-related changes in sleep vs. abnormal sleep in later life [51, 8].

When sleep hygiene education, stimulus control, sleep restriction, or relaxation training are used in various combinations, the intervention is known as multicomponent CBT; there is good evidence for the effectiveness of multicomponent CBT in improving insomnia symptoms in older adults as well as for sleep restriction/compression as a stand-alone treatment [32, 47, 55, 56, 57]. There is less evidence that sleep hygiene education, relaxation training or cognitive therapy improves insomnia symptoms in older adults when these are used as stand-alone therapies [32, 57]. CBT interventions are generally brief (e.g., one weekly session for four to eight weeks), but the effects, as compared to pharmacotherapy, are long-term [58, 52]. In a randomized control trial with adults experiencing chronic insomnia, there were short-term (3-months post–intervention) improvements in sleep efficiency and time awake after sleep onset for all three experimental groups (those receiving temazepam; those receiving CBT [including behavioral, cognitive, and educational components]; and those receiving both temazepam and CBT) compared to the placebo group as measured by sleep diaries and polysomnography, though, only the CBT-only group sustained these improvements at 24-months post–intervention [52]. Studies comparing CBT interventions to hypnotics have also found long-term improvements in total sleep time, total wake time, SWS, subjective sleep quality, and levels of distress, as compared to hypnotics, which showed only short-term improvements, attenuated improvements, or no improvement in these measures [58, 27, 52].

Benzodiazepine-receptor agonists, categorized as hypnotic benzodiazepines (BZDs)[1] or non-benzodiazepine hypnotics,[2] have been shown to be effective for the short-term treatment of insomnia complaints such as sleep onset latency, number of nighttime awakenings, total sleep time, and sleep quality, but there is no evidence of their effectiveness in the long-term [8, 59, 60, 61, 62]. Because there are risks associated with the long-term use of these medications, particularly by older adults, use of these medications beyond 35 days is not recommended [8]. Risks of long-term benzodiazepine use include developing tolerance or dependence; rebound insomnia; residual daytime sedation; cognitive impairment; and motor incoordination [8]. Additionally, both short-term and long-term use of nonbenzodiazepines has been associated with increased risk of falls in institutionalized older adults [63]. Due to the risks associated with pharmacotherapies and the equivalent or superior effects seen with behavioral and CBTs in the long run, use of these medications should generally be avoided in older people. The 2012 Beers Criteria from the American Geriatrics Society recommended against use of all benzodiazepine medications for insomnia among older adults, and recommended that non-benzodiazepine hypnotics be used for no

[1]estazolam, flurazepam, quazepam, temazepam, and triazolam
[2]zaleplon, zolpidem, and eszopiclone

more than 90 days in this population [64]. Off-label use of pharmaceutics, such as antidepressants, atypical antipsychotics, and anxiolytic benzodiazepine receptor agonists, has also been widely used for treatment of insomnia. However, little research has been done on these drugs in insomnia patients, and due to concern over efficacy and proper dosage, off-label pharmaceutics use is generally not recommended [65].

Randomized controlled trials have found that CBT interventions not only produce long-term improvements on both subjective and objective measures of sleep, but also are more cost-effective than pharmacotherapy [66, 67]. A trial comparing CBT to hypnotics in older adults found that while the initial cost of CBT intervention was greater, over time it was significantly more cost effective, including both costs of clinical implementation (e.g., training, supervision, and clerical support) and in increasing total quality-adjusted life years [67]. Importantly, evidence suggests that CBT can reduce hypnotic use, which is especially important in for older adults who are often long-term users of hypnotics, despite research suggesting that long-term use can lead to maintenance of insomnia [67]. These findings suggest that CBT is superior to pharmacotherapy in the long-term when considering both clinical and patient-centered outcomes and cost, and should be considered as a first-line therapy for chronic insomnia in older people.

Other treatments have been used to treat insomnia with varying degrees of effectiveness. Melatonin supplements and synthetic melatonin agonists have both been shown to improve sleep in older adults with insomnia [68, 65]. Melatonin supplements are taken one to two hours before bedtime to simulate the timing of the peak release of melatonin observed in younger adults [69]. Large randomized controlled trials have shown that older adults experience improvements in sleep latency, quality of sleep, morning alertness, and quality of life [70, 71]. Synthetic melatonin agonists have a faster onset time (0.75 hours) than melatonin supplements, and they produce many of the same results [65]. Randomized controlled trials have shown that older adults using melatonin agonists have improved sleep latency and sleep efficacy, and increased total sleep time, and do not show the same adverse effects commonly seen in hypnotic treatment [72, 73]. Despite these positive findings, there is still no overwhelming consensus that melatonin treatment is consistently effective for treating insomnia in older adults, and more research needs to be done [68]. Lifestyle interventions, which combine mild to moderate physical activity with social engagement, have also been used to treat sleep disruption in older adults [8, 46]. Research has found that these interventions can improve objectively measured quality of sleep, sleep-onset latency, sleep duration, sleep efficiency, and self-reported measures of subjective sleep quality [8, 29, 30, 45, 46], potentially because both exercise and social stimulation act as circadian synchronizers [28, 74]. Additionally, studies show that yoga, as opposed to more conventional forms of physical activity, may be useful in reducing joint pain and sleep disturbances in OA patients [26, 75]. While these findings are promising, more research needs to be done, particularly on the long-term benefits of these interventions.

5.1. Conclusion

To summarize, older adults commonly experience primary and comorbid insomnia. Nonetheless, useful measures and effective interventions are available to treat insomnia in this rapidly growing population. Behavioral and cognitive-behavioral therapies are safer and more effective alternatives to hypnotic medications in the long-term for treatment of insomnia in older people.

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