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Sleep and Its Disorders in Seniors

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1. Introduction

Over the past decade, our knowledge about age-related changes in sleep has significantly increased. We now know that there are both normal, age-related changes in sleep architecture and sleep patterns, as well as a variety of sleep complaints and sleep disorders that increase with age. This paper will review both normal and abnormal sleep in the elderly.

2. Sleep and Aging

Survey data show that half of elderly individuals report some form of sleep difficulty, including longer sleep onset times, lower rates of sleep efficiency, more time in bed, more awakenings during the night, earlier wake up times, and more daytime naps. Elderly individuals complain primarily about insomnia which is often comorbid with to other disorders. The symptoms in the elderly are more likely to be comorbid with an underlying physiological problem, rather than with stress as seen in younger adults.

A number of subjective changes in sleep are experienced in the elderly Box 1). Objective evidence of these subjective changes in sleep is corroborated by polysomnography (PSG) With age, sleep becomes more fragmented and lighter with an increase in the number of arousals and awakenings. There is a reduction in the amount of slow wave sleep (SWS) (stage 3 and 4), beginning in middle-age, with some evidence suggesting that SWS is completely absent after the age of 90 [1;2]. There is a compensatory increase in the stages 1 and 2, and there is a decrease in rapid-eye-movement (REM) sleep, which is proportional to the decrease in total sleep time. Sleep efficiency and total sleep time are reduced with age and there are an increased number of sleep stage shifts. Van Cauter et al.[3] found that total sleep time decreased on average by 27 minutes per decade from mid-life until the eighth decade in a sample of men aged 16 to

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83. Older adults spend more time in bed but have deterioration in both the quality and quantity of sleep.

All of these sleep changes can lead to excessive daytime sleepiness, which in turn can lead to napping (both intentional and unintentional). Objective tests (e.g., the Multiple Sleep Latency Test) of daytime sleepiness in the elderly show that they are sleepier than younger adults [4], suggesting that the elderly may not be able to obtain an adequate amount of nighttime sleep [5].

It is still not clear whether older adults need less sleep; however, it is clear that there is a reduced ability to obtain adequate sleep in this population [1;6]. This reduced ability can be linked to several potential causes, including changes in the endogenous circadian clock; specific sleep disorders (e.g., sleep-related breathing disorder, periodic limb movements in sleep); medical and psychiatric illness; and medication intake (Box 2). Effective treatments exist for many of these sleep difficulties. Given the high prevalence of sleep complaints and sleep disorders in this population and the link between insufficient sleep and heightened levels of morbidity and mortality, there is a clear need for increased awareness, assessment, and treatment of sleep disturbances in the elderly.

3. Circadian Rhythm Disturbances

Circadian (24-h) rhythms are biological rhythms or changes that control many physiologic functions, including core-body temperature, endogenous hormone secretions, and the sleep-wake cycle. These rhythms originate in the suprachiasmatic nucleus (SCN) in the anterior hypothalamus, which houses the internal circadian pacemaker. The rhythms are also under the control of external cues such as light, time of day, social activities and meals. Circadian rhythm sleep disturbances typically develop when there is a dysynchrony between the internal circadian pacemaker and external environment demands.

Several factors likely contribute to circadian rhythm desynchronization in the elderly. First, the SCN deteriorates with age, which may result in weaker and/or more disrupted rhythms [7]. Second, other circadian rhythm disturbances known to be involved in the entrainment of the circadian rhythm of sleep may develop such as the gradual reduction of nocturnal secretion of melatonin with age [8]. The decline in melatonin secretion may result in reduced sleep efficiency and an increased incidence of circadian rhythm sleep disturbances. Third, elderly patients may have exogenous cues that are too weak to entrain the circadian rhythm of sleep-wake. For example, light is one of the most powerful zeitgebers (literally “time-giver” or cues), yet studies have shown that elderly patients, especially those who are institutionalized, spend too little time in daylight. Exposure to daily bright light averages about 1 hour for healthy elderly, 30 minutes for Alzheimer’s disease patients living at home, and less than 10 minutes for nursing home patients [9–12]. This reduced level of bright light is associated with nighttime sleep fragmentation and circadian rhythm sleep disorders [12].

Another common circadian rhythm change in older age is a shift in the timing of the sleep/wake cycle. Many older patients experience a phase advance in their sleep-wake cycle, causing them to feel sleepy early in the evening. Individuals with advanced sleep phase syndrome (ASPS) will typically fall asleep between 7 to 9 pm and wake up 3 to 5 am. Not uncommonly, many older individuals may stay up late in spite of their sleepiness, yet still awaken early in the morning due to their advanced sleep-wake cycle. This cycle can cause sleep deprivation, excessive daytime sleepiness and subsequent daytime napping. Finally, the amplitude (i.e., the difference in the level between the peak and trough values) [please define] of the circadian rhythm may also decrease with age, which can increase the frequency of nighttime awakenings and the severity of excessive daytime sleepiness [13].

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Circadian rhythm changes are considered to be common with age, and presenting symptoms may mimic those of primary insomnia, which will be further discussed below. Making a distinction between the two disturbances is important, however, as each warrants different treatment approaches. In addition to a careful and detailed sleep history, sleep diaries and activity monitoring with wrist actigraphy can be useful in distinguishing between the two conditions.

The most appropriate therapies for shifts in the circadian rhythm are those known to strengthen and entrain the sleep-wake cycle. Because light is the strongest cue for circadian entrainment, one of the most effective and common treatments for circadian rhythm shifts is bright light therapy. Evening light exposure has been found to delay circadian rhythms and strengthen the sleep-wake cycle in both healthy community living older subjects as well as in nursing home patients [14;15]. Patients with advanced rhythms should spend more time outdoors during the late afternoon or early evening and avoid bright light in the morning hours. If patients are unable to spend enough time outdoors, studies have shown that exposure to artificial light via a bright light-box in the early evening can improve sleep continuity in both healthy and institutionalized elderly patients [14;16]. In addition, a regular sleep schedule helps to promote a stronger sleep-wake cycle.

As discussed above, endogenous secretion of melatonin is known to promote sleep and is reduced in older adults. Some studies suggest that melatonin replacement therapy may improve sleep efficiency in this population [17;18]. However, there is little consensus on the recommended dose or timing of administration. In addition, melatonin is not regulated by the Food and Drug Administration, and therefore, there is no control over the purity and exact drug composition of the various brands currently available. Little is known about the possible drug interactions or side effects related to the administration of melatonin long term. Therefore, clinicians should exercise caution when considering a trial of melatonin replacement therapy in elderly patients. The NIH State-of-the-Science Insomnia Conference concluded that although melatonin appears to be effective for the treatment of circadian rhythm disorders, there is little evidence for efficacy in the treatment of insomnia [19]. They also concluded that there is no definition of an effective dose. While melatonin is thought to be safe in the short term, there is no information about the safety of long-term use [19]. It should be noted, however, that the Federal Drug Administration recently approved the first melatonin agonist, ramelteon, for the treatment of sleep-onset insomnia [20].

4. Insomnia

Insomnia is defined as the inability to initiate or maintain sleep that results in daytime consequences. Studies have found insomnia to be the most common sleep disturbance in older adults, with up to 40%–50% of those over the age of 60 reporting difficulty sleeping [21] and an annual incidence rate of 5% in those over the age of 65 [22]. Insomnia complaints include difficulty falling asleep, difficulty staying asleep and early morning awakenings Women tend to have higher rates of insomnia than men [23].

There are a variety of factors associated with, or comorbid with insomnia in the elderly including depression and other psychiatric conditions, medical conditions, medications, and circadian rhythm disturbances [24]. Foley et al. [22] reported that only 7% of the incident cases of insomnia in the elderly occur in the absence of one of these risk factors.

Depression[s1]

Patients with insomnia often have co-morbid psychiatric conditions. In the classic study by Ford and Kamerow [25], 40% of insomnia patients had a psychiatric diagnosis, with anxiety being the most common, followed closely by depression. The same study also showed that

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persistent insomnia was associated with an increased risk of a future psychiatric disorder. However, studies have suggested that insomnia also puts an individual at greater risk for a new, future episode of depression.[26–30]. In a study by Weissman et al. [31], over 7000 adults with insomnia were followed for one year. The results confirmed that the odds ratio of a new onset psychiatric disorder in the baseline insomnia group was 5.4 for major depression, 20.3 for panic disorder and 2.3 for alcohol abuse. The Breslau et al. [32] and Chang et al. [33] studies showed similar results. However, these studies have primarily been conducted in younger adults. The only study to include older adults was a study by Roberts et al [34] of 2370 community residents with a mean age of 64.9 years. Survey data were collected at baseline and again one year later. The prevalence of insomnia at baseline was 23%. At follow-up, for those who had either had insomnia one year previously, or still had insomnia, there was an 8.08 odds ratio for new-onset major depression. More data examining the co-morbid relationship between psychiatric disorders and insomnia in the elderly are needed.

The overall conclusions from research studies are that about 20% of patients with insomnia have depression, and about 90% of patients with depression report a sleep disturbance. Insomnia therefore can be a symptom of depression, can contribute to the onset of depression or depressive episodes, can predict a prognosis and response to antidepressant therapy, be linked to recurrence/relapse of depression and be linked to anxiety and other psychiatric disorders [35].

As insomnia and depression are considered co-morbid conditions [19], the treatment implications are that the two conditions should be treated concurrently. In a study by Fava et al. depressed patients were randomized to either a fluoxetine/placebo arm or a fluoxetine/eszopiclone arm. As might be expected, for those on both an antidepressant and a sedative hypnotic, sleep was significantly longer and less disrupted than for those on fluoxetine and placebo. Of even greater interest however, is the response to depression was also greater in the group treated concurrently [36]. While these data were also in younger adults, the results suggest that treating the psychiatric condition as the same time as treating the insomnia might result in a better overall response. It is important to remember, however, that hypnotic agents are not FDA indicated for the treatment of depression.

Sleep and Medical Illness

Older individuals often suffer from medical comorbidity. In a National Sleep Foundation survey of adults aged 65 years and over, those with more medical conditions, including cardiac and pulmonary disease and depression, reported significantly more sleep complaints [37]. Osteoarthritic pain, shortness of breath due to chronic obstructive pulmonary disease or congestive heart failure, nocturia due to enlarged prostate, and neurologic deficits related to cerebrovascular accidents or Parkinson's disease all can lead to difficulty with sleep initiation and maintenance. Studies examining the prevalence of sleep disturbances in patients with chronic medical diseases have reported that 31% of arthritis and 66% of chronic pain patients report difficulty falling asleep, while 81% of arthritis, 85% of chronic pain, and 33% of diabetes patients report difficulty staying asleep [38;39].

Sleep and Medications

The issue of polypharmacy is of significant concern in the elderly. The medications used to treat the underlying geriatric medical problems can also cause disruptions in sleep. Bronchodilators, β-blockers, corticosteroids, decongestants, diuretics are all well-known to cause sleep disturbances, as are other cardiovascular, neurologic, psychiatric, and gastrointestinal medications. Whenever feasible, the offending medications should be stopped, or at minimum the dose and timing adjusted. Sedating medications should be administered prior to bedtime while stimulating medications and diuretics should be taken during the day.

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Insomnia Treatment

Treatments for insomnia are comprised of behavioral, pharmacological and combined treatment approaches.

Nonpharmacological Interventions—Nonpharmacological interventions are effective in the treatment of insomnia [19;40]. Good sleep hygiene, or the practice of appropriate sleep behaviors, provides the basis for the behavioral approach to insomnia (see Box 3). Poor sleep hygiene practices can be associated with behavioral patterns that contribute to sleep disturbances. Patients should be educated on how to identify specific factors that affect their own sleep. The use of alcohol, which is widely used as a sleep aid due to its ability to shorten sleep latency, should be discouraged, as it has been shown to contribute to sleep fragmentation and early morning awakenings [41].

Two commonly prescribed behavioral therapies are stimulus control therapy and sleep restriction therapy. Stimulus control (SC) is based on the belief that insomnia may be the result of maladaptive classical conditioning [42]. Patients are instructed to eliminate all in-bed activities other than sleep, such as reading and television watching. If they are not able to fall asleep within 20 minutes, they are instructed to get out of bed until they feel sufficiently sleepy, when they can return to bed and attempt to again fall asleep. If they are not able to fall asleep within 20 minutes, the pattern of getting out of bed until sleepy repeats itself. This therapy tries to break the association between the bed and wakefulness.

Sleep restriction therapy (SRT) limits the time spent in bed to about fifteen minutes beyond the duration of time spent asleep at night [43]. As sleep efficiency improves (i.e., the amount of sleep relative to the amount of time in bed), the time in bed gradually increases.

Cognitive Behavioral Therapy—CBT for insomnia involves educational, behavioral and cognitive components. The educational component involves encouraging the patient to determine which factors might be predisposing, precipitating or perpetuating the insomnia. The therapist explains that CBT-I is effective by eliminating the perpetuating factors with behavioral and cognitive strategies. The behavioral component involves the behavioral techniques (i.e., SC, SRT) described above. The cognitive component deals with the maladaptive thoughts or dysfunctional beliefs that the patient has about the insomnia.

Cognitive behavioral therapy (CBT) has been shown to be as effective as medications in the short-run and to have better long-term outcomes in the treatment of insomnia, in both younger and older adults [44]. In an 8-week double-blind treatment longitudinal outcome study, CBT, an intermediate-acting benzodiazepine (temazepam), a combined CBT/temazepam condition, and a placebo condition were compared in a sample of older adults [45]. Compared to baseline, all three active treatments reduced night wakings at post-treatment, however only CBT alone and CBT/temazepam were associated with continued improvement at 3, 12 and 24-month follow-up interviews. In addition, one study found even two 25-miunte CBT sessions for insomnia are effective in reductive nocturnal awakenings, which may be a more practical approach in the primary care setting. The NIH 2005 State-of-the-Science conference on insomnia concluded that CBT is the most effective treatment for insomnia: that CBT has demonstrated efficacy, that CBT is as effective as prescription medications for brief treatment of chronic insomnia, that the beneficial effects of CBT (in contrast to those produced by medications) may last well beyond the termination of treatment, and that there is no evidence that CBT produces adverse effects [19]. Although pharmacologic treatments may be of more immediate help in the acute treatment phase, non-pharmacological or combined approaches may be more effective for long-term clinical gains.

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Pharmacological Interventions: Historically, a number of different classes of medications have been used to treat insomnia in the elderly including sedative-hypnotics, antihistamines, antidepressants, antipsychotics and anticonvulsants. The 2005 NIH State-of-the-Science Conference on Insomnia concluded with several recommendations regarding medications for insomnia [19]. All antidepressants have potentially significant adverse effects, raising concerns about their risk–benefit ratio. Barbiturates and antipsychotic medications have significant risks, and thus their use in the treatment of chronic insomnia cannot be recommended at this time.

There is particular concern with the use of antihistamines for insomnia in the elderly. Although these drugs are easy to obtain and are cheap, In a study of 426 older hospitalized medical patients, all ≥ 70 years, 27% received 25–50 mg diphenhydramine during hospitalization. Compared to patients who were not given diphenhydramine, these patients were shown to be at increased risk for any delirium symptoms, inattention, disorganized speech, altered consciousness, urinary catheter placement and longer median length of stay. A dose-response relationship was demonstrated for most adverse outcomes [46]. The NIH concluded that there is no systematic evidence for the efficacy of antihistamines, yet there are significant concerns about the widespread use and risks with these agents, particularly in the older patient.

Sedative-hypnotic medications are at times appropriate for the management of insomnia, and choosing the sedative-hypnotic that best fits the specific complaint related to insomnia is the key to using this class of medications successfully. Potentially harmful effects must be taken into account when prescribing sedative-hypnotics, particularly benzodiazepines, in the elderly. The administration of long-acting hypnotics can cause adverse daytime effects such as excessive daytime sleepiness and poor motor coordination, which can lead to injuries [47]. In the elderly, the risk of falls, cognitive impairment, and respiratory depression are of particular concern, although some recent studies have suggested that while insomnia is a risk for falls, hypnotic use is not.[48] Chronic use of long-acting benzodiazepines can lead to tolerance and withdrawal symptoms if abruptly discontinued, and the benefits of these agents for long-term use have not been studied with randomized clinical trials. Additionally, the potential for exacerbating coexisting medical conditions such as hepatic or renal disorders exists when these medications are used.

The newer selective short-acting type-1 GABA benzodiazepines receptor agonists (BzRA's) (i.e., zolpidem [49;50], zolpidem [51], zaleplon [52;53], eszopiclone [54;55] have been shown to be effective in older adults, with a low propensity for causing withdrawal, dependence, tolerance, or clinical residual effects. All were shown to either by decreasing the time it takes to fall asleep and/or by increasing total sleep time. In younger adults, eszopiclone has been found to be safe and effective in the long-term treatment of chronic insomnia [56]. However, these long-term studies have not yet been published in older adults. Ramelteon, a melatonin agonist, has also been shown to be safe and effective in the treatment of insomnia in older adults [57]. The NIH concluded that while the older benzodiazepines are safe in the short-term treatment of insomnia, the frequency and severity of adverse effects are much lower in the newer non-benzodiazpines [19]. However, the NIH panel also expressed significant concerns about the risks associated with the use of these medications in older adults.

5. Primary Sleep Disorders

Three primary sleep disorders are commonly found in the elderly: sleep-related breathing disorder (SRDB), restless legs syndrome/periodic limb movements in sleep (RLS/PLMS), and REM sleep-behavior disorder (RBD).

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Sleep-Related Breathing Disorder

Sleep-related breathing disorder (SRBD) has been shown to be quite common in the elderly. In the largest series of randomly selected community dwelling elderly (65 to 95 years of age) Ancoli-Israel et al. [58] reported that 81% of the study subjects had an AHI≥ 5, with prevalence rates of 62% for an AHI ≥ 10, 44% for an AHI ≥ 20, and 24% for an AHI ≥ 40. The Sleep Heart Health Study studied a large cohort of 6400 patients with a mean age of 63.5 (range: 40 to 98 years) and reported on prevalence rates of SRBD by 10-year age groups: for those aged 60–69, 32% had an AHI 5–14 and 19% had an AHI≥15; for those aged 70–79, 33% had an AHI 5–14 and 21% had an AHI≥15; for those aged 80–98, 36% had an AHI 5–14 and 20% had an AHI≥15 [59]. In contrast, middle-aged adults 30 to 60 years of age have an estimated prevalence of 4% in men and 2% in women (with SRBD defined as AHI ≥ 5 and the presence of excessive daytime somnolence) (Young et al. [60].

Longitudinal and cross-sectional studies have both shown that the prevalence of SRBD increases or stabilizes with increasing age [58;59]. The Sleep Heart Health Study found a small increase in SRBD prevalence with increasing 10-year age groups for those subjects with an AHI≥15 [59]. In a longitudinal study where older adults were followed for 18 years, Ancoli-Israel et al. [61] found that AHI remained stable and only changed with associated changes in body mass index.

Elderly nursing home patients, in particular those with dementia, have been shown to have higher prevalence rates of SRBD than those who live independently, with prevalence rates ranging from 33–70% [62;63]. Several studies have also found that the severity of the dementia was positively correlated with the severity of the SRBD [62;64]. Despite these findings, several other studies have failed to show a significant difference in the amount of SRBD in demented elderly when compared to age-matched controls [65;66].

SRBD risk factors in the elderly include increasing age, gender, obesity, and symptomatic status [67]. Other factors that increase the risk of developing SRBD include the use of sedating medications, alcohol consumption, family history, race, smoking, and upper airway configuration [67].

Snoring and excessive daytime sleepiness are two principal symptoms of SRBD in the elderly. Other less common presentations in the elderly include insomnia, nocturnal confusion, and daytime cognitive impairment including difficulties with concentration and attention, and short-term memory loss. It is also not uncommon for the symptoms and clinical presentations of SRBD to be similar to that of younger adults.

Approximately 50% of patients with habitual snoring have some degree of SRBD, and snoring has been identified as an early predictor of SRBD [68]. In subjects 65 years and older, Enright et al. [69] found that loud snoring was independently associated with BMI, diabetes, and arthritis in elderly women and alcohol use in elderly men, but that self-reported snoring decreased with age. It should be noted, however, that not all patients who snore have SRBD and not all patients with SRBD snore. As many elderly live alone, this symptom may be difficult to identify.

Excessive daytime sleepiness (EDS) results from recurrent nighttime arousals and sleep fragmentation and is a major feature of SRBD in the elderly. The presence of EDS may be manifested as unintentional napping as individuals may fall asleep at inappropriate times during the day such as while watching television or movies, while reading, during conversations, while working, and while driving. EDS can cause reduced vigilance and is associated with cognitive deficits which may be particularly serious in older adults who may already have some cognitive impairment [70].

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There is a rapidly evolving body of literature on cardiovascular consequences related to SRBD, including hypertension, cardiac arrhythmias, congestive heart failure, myocardial infarction, and stroke. However, most of the research to date has focused on younger or middle-aged adults, and therefore, the exact relationship between SRBD and these comorbidities in the elderly remains unknown.

Earlier studies have reported a positive association between SRBD and hypertension in the elderly [71]. The Sleep Heart Health Study found no association between SRBD and systolic/diastolic hypertension in those aged ≥60 years [72]. However, the SHHS did find a positive association between the SRBD severity and the risk of developing cardiovascular disease including coronary artery disease and stroke as well as the development of congestive heart failure [73]. Importantly, even mild to moderate SRBD was associated with its development.

The negative effect of severe SRBD (AHI≥30) on cognitive dysfunction in the healthy elderly is well established, with consistent reports of impairment on attentional tasks, immediate and delayed recall of verbal and visual material, executive tasks, planning and sequential thinking, and manual dexterity [74]. Studies examining the relationship between milder SRBD and cognition are less clear-cut, as some studies have found that milder SRBD (AHI 10–20) does not cause cognitive dysfunction in the absence of sleepiness [75].

In addition to the cognitive deficits that may occur as a result of SRBD, there is evidence that many of the progressive dementias including Alzheimer's disease and Parkinson's disease involve degeneration in areas of the brainstem that are responsible for regulating respiration and other autonomic functions relevant to sleep maintenance. This degeneration may place the patient at an increased risk of developing SRBD. For example, Ancoli-Israel et al. [62] found that those institutionalized elderly with severe dementia had more severe SRBD compared to those with mild-moderate or no dementia. Furthermore, those with more severe SRBD performed worse on the dementia rating scales, suggesting that more severe SRBD was associated with more severe dementia.

Higher rates of mortality are seen with SRBD. In general, rates from all causes increase 30% during the night, and for those aged 65 and over, the excess deaths typically occur between the hours of 2 am and 8 am [76]. The presence of unrecognized or untreated SRBD may partially account for these findings as several studies have found an association between SRBD in the elderly and increased mortality rates [77;78], although some studies of community dwelling, nondemented elderly subjects have not found AHI to be an independent predictor of mortality [79;80]. Rather than directly causing an increased mortality, these studies have found that SRBD may be one of several predisposing factors for cardiopulmonary disease, which, in combination, leads to increased mortality. This hypothesis is strengthened by a study by Ancoli-Israel et al. [81] which reported that elderly men with congestive heart failure (CHF) had more severe SRBD than those with no heart disease, and men with both conditions (CHF and SRBD) had shortened life spans compared to those with just CHF, just SRBD, or neither. More studies need to be undertaken to better understand the exact nature of the relationship of SRBD and mortality in the elderly, including studies specific to older women as most of the studies completed in this age category have involved predominantly men.

To accurately assess the SRBD in the elderly, a multiple step process should be employed. A complete sleep history should be obtained, focusing on symptoms of SRBD including EDS, unintentional napping, snoring, symptoms of other sleep disorders (i.e., restless legs syndrome) [spelling], and sleep-related habits and routines, if possible, in the presence of a bedpartner, roommate or caregiver. The patient's medical history, including psychiatric and medical records should be thoroughly reviewed, paying particular attention to associated medical

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conditions and medications, the use of alcohol, and evidence of cognitive impairment. Lastly, when the above is suggestive of SRBD, an overnight sleep recording should be obtained.

Treatment of SRBD in the elderly should be guided by the significance of the patient's symptoms and the severity of the SRBD [82]. Patients with more severe SRBD (AHI > 20) deserve a trial of treatment. For those with milder SRBD (AHI < 20), treatment should be considered if co-morbid conditions are present, such as hypertension, cognitive dysfunction, or EDS. Age alone should never be a reason to withhold treatment, nor should assumed noncompliance [83].

There are a number of effective treatments for SRBD. Continuous positive airway pressure (CPAP) is the gold standard treatment for SRBD and provides positive pressure via the nasal passages or oral airway, creating a pneumatic splint to keep the airway open during inspiration. When used appropriately, CPAP has been shown to safely and effectively manage SRBD at night with minimal side effects. Three months of compliant CPAP use in older adults has been reported to improve cognition, particularly in the areas of attention, psychomotor speed, executive functioning, and non-verbal delayed recall [74].

CPAP compliance can be an issue for any adult with SRBD, and clinicians should not assume that elderly patients would be noncompliant simply due to age. Our laboratory has determined that patients with mild-moderate Alzheimer's disease and SRBD can tolerate treatment with continuous positive airway pressure devices [84], and the only factor associated with poor CPAP compliance was the presence of depression; age, severity of dementia, or severity of SRBD were not associated with poor compliance [84].

Alternatives to CPAP include oral appliances and surgery, however neither has been shown to be as effective as CPAP. All patients should be counseled on weight loss and smoking cessation, if indicated. Longer-acting benzodiazepines should generally be avoided in the elderly with SRBD as most of these medications are respiratory depressants and may actually increase the number and duration of apneas. Elderly patients with SRBD should be encouraged to abstain completely from alcohol consumption, as even small amounts can make SRBD worse.

While there is a growing body of literature exploring SRBD in the elderly, there is also an ongoing debate in the field as to what the presence of SRBD in the elderly means. Some propose that a distinction should be made between age-dependent conditions, in which aging causes the pathology, and age-related conditions, in which the disease only occurs during a particular age period [85]. Whether SRBD is an age-dependent or an age-related condition remains unknown. Ancoli-Israel et al. [58] and others [86–88] have found that the prevalence of SRBD increases with age and therefore, SRBD may be thought of as an age-dependent condition. If this is the case and SRBD in older adults is the same condition with the same outcomes, then the presence of SRBD in the elderly would warrant the same aggressive treatment. However, while the prevalence of SRBD in the elderly may be age-dependent, the severity of the SRBD and its clinical significance in the elderly may be age-related. As mentioned above, Ancoli-Israel et al. [61] showed in an 18-year follow-up study of elderly patients with SRBD that AHI did not continue to increase with age, and that if the patient's BMI remained stable, so did the AHI. Bixler et al. [88] reported in a sample of older men that the prevalence of SRBD increased but that after controlling for BMI, the severity based on number of events and oxygen saturation actually decreased with age. Studies aimed at answering these questions as well as those related to mortality and SRBD in the elderly are ongoing [83]

In conclusion, in terms of treatment, it does not matter if sleep apnea in older adults is the same as sleep apnea in younger adults, The driving force behind the decision whether to treat or not to treat should be the clinical presentation of the patient and consequences of sleep apnea that

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patient is experiencing. The bottom line is that if the sleep apnea is associated with clinical symptoms, then it should be treated, regardless of the age of the patient [83].

Periodic Limb Movements in Sleep / Restless Legs Syndrome

Insomnia complaints may be associated with restless legs syndrome and/or with periodic limb movements in sleep. While the prevalence of restless legs syndrome is about 10% in younger adults, several studies have shown that the prevalence almost doubles with age [89;90]. The prevalence of a related disorder, periodic limb movements in sleep, also increases with age [91].

Pharmacologic intervention is required to manage RLS/PLMS. Dopamine agonists are effective in both reducing the number of kicks and associated arousals and are the FDA approved treatments for RLS, specifically ropinirole and pramipexole. However, the therapeutic studies have only been conducted in younger adults.

Rapid Eye Movement Sleep-Behavior Disorder

REM sleep-behavior disorder (RBD) is characterized by the intermittent absence of normal skeletal muscle atonia during REM sleep, associated with excessive motor activity while dreaming and typically occurring during the second half of the night when REM is more common. Patients may walk, talk, eat, or appear to be acting out their dreams, which can result in violent movements that are potentially harmful to themselves and their bed partner. Vivid dreams, consistent with the patient's aggressive and/or violent behavior may be recalled upon waking.

The exact prevalence of RBD is unknown but studies have found it to be most common in elderly men [92;93]. Although the etiology of RBD remains unknown, there appears to be a strong association between idiopathic RBD and degenerative neurologic diseases, including Parkinson's disease, multiple system atrophy, and Lewy Body Dementia [92;94;95]. In addition, in many cases of neurodegenerative disease, RBD may precede other symptoms of the neurodegenerative disorder by years [92;95;96]. Olson et al. [92] reported that 50% of patients diagnosed with idiopathic RBD developed Parkinson's disease or multiple system atrophy within 3–4 years. Schenck et al. [96] found that Parkinsonism developed in 38% of men, a mean of 3.7 years after an initial diagnosis of idiopathic RBD. Withdrawal of REM suppressing agents such as alcohol, tricyclic antidepressants, amphetamines, cocaine have been strongly linked to the onset of acute RBD [92;97]. Other medications and conditions reported to induce acute RBD including monoamine oxidase inhibitors, fluoxetine, and stress disorders [92;97].

As with other primary sleep disorders, the diagnosis of RBD requires a thorough sleep history along with bed partner report, if possible. The RBD diagnosis requires a simultaneous overnight polysomnogram (PSG) and video recording of the nighttime behavior, in order to confirm a relationship between REM sleep and the complex motor behaviors exhibited by the patient. Upon reading the PSG, clinicians should pay close attention to intermittent elevations in muscle tone or limb movements during REM sleep, which should be relatively rare.

The treatment of choice for RBD, although used off-label, is clonazepam, a long-acting benzodiazepine. Although not in randomized clinical trials, clonazepam has been shown to result in partial or complete cessation of abnormal nocturnal motor movements in 90% of patients [98]. However, patients may complain of residual sleepiness due to its long half-life, and it is contraindicated in patients with co-existing SRBD. Several alternative medications have shown some positive effects in RBD including carbamazepine [99], melatonin [100], and dopaminergics agents [101], although none has been shown to be as effective as clonazepam.

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In addition to pharmacologic treatment, sleep hygiene education of the patient and the bed partner are important aspects of RBD treatment, including: 1) Efforts to make the bedroom safer (such as removing heavy or breakable or potentially injurious objects from the bed's vicinity); 2) Heavy curtains should be placed on bedroom windows and doors and windows should be locked at night; and 3) To avoid falling out of bed, patients may consider sleeping on a mattress on the floor.

6. Sleep in Dementia

There is considerable evidence that dementia affects sleep differently from the normal aging process [1]. This is not surprising considering that dementing illnesses such as Alzheimer's disease, Parkinson's disease, multi-infarct dementia, or Lewy Body dementia may involve irreversible damage to the brain in areas responsible for regulating sleep. In general, patients with dementia have disturbed sleep at night, and laboratory sleep studies of demented patients have found increased sleep fragmentation and sleep onset latency, and decreased sleep efficiency, total sleep time, and slow wave sleep [13]. Furthermore, the severity of dementia appears to be associated with the severity of the sleep disruption [102].

Due to these changes in sleep architecture, patients with dementia may have excessive daytime sleepiness, nighttime wandering, confusion and agitation (sundowning). Such nighttime behavior and disruptions may eventually lead to institutionalization [103]. Therefore, addressing the issues related to sleep disturbances in the community-dwelling demented elderly is especially important, as it may potentially enable caregivers to postpone institutionalization.

It may be difficult to determine the exact nature of the sleep disturbance in patients with dementia although caregivers can be a valuable source of information. The same causes of sleep disruption in the non-demented older adult will also be found in the patient with dementia. Pain from medical illnesses, medications, circadian rhythm changes, and depression are all potential causes of sleep disturbances in this population. It is also important to inquire about treatable primary sleep disorders such as sleep-related breathing disorder (SRBD), restless leg syndrome (RLS) or periodic limb movements in sleep (PLMS). Depending on the severity of the dementia, overnight sleep studies may not be an option and therefore, actigraphy may serve as a useful method to assess sleep and circadian rhythms in these patients [104].

Treatment of specific sleep disturbances in the elderly with dementia should be guided by that specific sleep disorder. SRBD should be treated with continuous positive airway pressure (CPAP), RLS/PLMS should be treated with a dopamine agonist, and circadian rhythm disturbances should be treated with bright light therapy. Maintenance of regular physical activity and social interaction can also promote a more robust sleep/wake cycle. Sedative-hypnotics including benzodiazepines, tricyclic antidepressants, antihistamines, anticonvulsants and antipsychotics are frequently prescribed in an off-label fashion for the nighttime restlessness associated with dementia. However, attempting to enhance sleep continuity with these medications may paradoxically result in increased sleep disturbance and daytime sleepiness. Due to the many side effects associated with these medications including drug interactions and residual daytime sleepiness ("hang over effect") resulting in impaired motor and cognitive function, nonpharmacological interventions are preferred. In addition, the FDA recently put a "black-box" warning on the use of the atypical antipsychotics agents in patients with dementia.

7. Sleep in Institutionalized Elderly

Institutionalized elderly experience extremely fragmented sleep [105]. Middelkoop et al. [106] reported that patients living in nursing homes had poorer sleep quality, more disturbed sleep onset, more phase-advanced sleep periods, and higher use of sedative-hypnotics when

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compared with those elderly living in the community or in assisted living environments. Studies have found that for older adults living in nursing homes, not a single hour in a 24-hour day was spent fully awake or fully asleep [102;105;107].

There are a variety of environmental factors that contribute to the reduction in sleep quality. Noise and light exposure occur intermittently throughout the 24-hour day. Schnelle et al. [108] demonstrated that both ambient light and nighttime noise contributed significantly to sleep disruption in nursing home patients. This study also found that those patients living in nursing homes where nighttime noise and light were kept to a minimum had better sleep. Ancoli-Israel and Kripke [105] reported that the nursing home patients were exposed to less than 10 minutes of bright light per day and those with more light exposure had fewer sleep disruptions [12]. Chronic bed rest is known to disrupt circadian rhythms yet institutionalized patients typically spend large amounts of the 24-hour day in bed [105]. Changes in sleep hygiene and the sleep environment may greatly improve the sleep quality of nursing home inhabitants. Strategies to reduce nighttime disturbances and to promote stronger sleep/wake cycles are consistent with those listed in Box 3.

8. Summary

Significant changes in sleep accompany aging for most adults. There are a variety of potential causes including medical illnesses, medications, circadian rhythm disturbances, depression and other psychiatric disorders, and primary sleep disorders (SRBD, RLS/PLMS, and RBD). The diagnosis requires a good sleep history and when indicated, a sleep study. Treatment should address the primary problem rather than the complaint itself and can result in significant improvement in quality of life and daytime functioning in the elderly.

Box 1: Sleep Complaints in Older Adults

Increase in time to fall asleep

Spend less time asleep

Increase in number of awakenings

Spend too much time in bed

Less satisfied with nighttime sleep

Significant increase in daytime sleepiness

Napping more often and longer

Box 2: Causes of Sleep Disturbances in Older Adults

Circadian rhythm changes

Primary sleep disturbances (e.g. SRBD, PLMS, RBD)

Medical illness (e.g. hyperthyroidism, arthritis)

Psychiatric Illness (e.g. depression, anxiety disorders)

Multiple medications

Dementia

Poor sleep hygiene habits

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Box 3: Sleep Hygiene Rules for Older Adults

Check effect of medication on sleep and wakefulness

Keep a regular bedtime-waketime schedule

Avoid naps or limit to 1 nap a day, no longer than 30 minutes

Restrict naps to late morning or early afternoon

Avoid caffeine, alcohol, and tobacco after lunch

Increase overall daytime light exposure (e.g., spend more time outside, especially late in the day)

Exercise regularly

Eat a light snack (i.e. milk, bread) before bed

Limit liquids in the evening

Do not spend too much time in bed

Get out of bed if unable to fall asleep

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