

# Sleep and Cognitive Impairment in the Elderly

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## ABSTRACT

Elderly people have various types of health problems, not only related to degenerative processes but sleep disturbances are also one of the problems that are often faced by elderly patients. Elderly sleep disorders are very varied and cannot be underestimated. Sleep disorders in the elderly can be in the form of insomnia, obstructive sleep apnea, and sleep related movement. Good management will help the elderly to have good quality sleep and prevent long-term drug use. Sleep disorders in the elderly also cannot be ruled out from various metabolic diseases and psychological stress, so an understanding of sleep disorders in the elderly is needed. This review aims to present a brief review of sleep disorders in the elderly, so that understanding regarding sleep disorders can be further understood.

**Keywords:** Elderly, Sleep disorder, Good Quality of Sleep

## INTRODUCTION

Sleep is a physiological necessity for every human being and is also related to various physiological changes in the body. Sleep disturbances can serve as indicators of certain diseases. Several studies have indicated that sleep disorders are one of the clinical manifestations of neurodegenerative diseases such as dementia and Parkinson's. Approximately 40% of geriatric patients aged 65 and above experience sleep disturbances.<sup>[1]</sup> There are several continuous and profound changes that contribute to the aging process and affect sleep in the elderly. Both physical and psychological changes

that occur during aging can influence a person's sleep quality and quantity. Subjective and objective complaints in assessing sleep disturbances will impact the screening process, making regular monitoring of sleep disorders in elderly patients essential.<sup>[2]</sup>

## DISCUSSION

### The Physiological Process of Sleep

The sleep process is divided into two phases: REM (rapid eye movement) and NREM (non-rapid eye movement). The NREM sleep phase is further divided into three stages: NREM stage 1, NREM stage 2, and NREM stage 3. Studies comparing sleep processes between young adults and the elderly have shown that young adults do not experience deep sleep in NREM stage 3. The sleep regulation system in NREM stage 3, also known as deep sleep, increases the pressure for homeostasis in young adults, leading to reduced daytime sleep while experiencing deep and restful sleep at night.<sup>[2]</sup> This condition can affect activity levels and overall health in the elderly. NREM stage 1 is also known as drowsiness or feeling sleepy. It is a transitional phase characterized by slow eye movements. Alpha waves appear on and off, followed by theta waves with vertex waves. NREM stage 2 is marked by a reduction in delta waves by less than 20%, along with K complexes and sleep spindles. NREM stages 3 and 4 together are referred to as sleep with delta rhythms or slow-wave sleep. During this phase, the body undergoes restorative

processes to refresh and restore after daily activities. REM phase consists of both phasic and tonic components. During the phasic phase, muscle twitches can occur, along with increased blood flow to the brain, irregular heart rate, and breathing patterns. The duration of sleep decreases with age.<sup>[3]</sup> Various sleep disorders that can be experienced by the elderly include obstructive sleep apnea (OSA), restless legs syndrome, and insomnia.

### Sleep and Aging Process

Based on ICSID III (International Classification of Sleep Disorders, Third Edition), sleep disorders are divided into six major groups: insomnia, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, parasomnia, and sleep-related movement disorders. Several previous studies have indicated a strong

association between insomnia and dementia. The duration of sleep, from childhood to old age, particularly the total sleep time, tends to decrease with age. Research shows that the average reduction in total sleep time is about 8 minutes per decade in men and 10 minutes in women. <sup>[4]</sup> The total sleep time tends to stabilize at the age of 60. According to meta-analyses research on sleep initiation, the ability to fall asleep or feel drowsy will increase after the age of 60. However, maintaining sleep becomes more challenging as a person gets older, and the ability to maintain sleep will decrease gradually with age. Moreover, an increase in the arousal index is observed at around the age of 50, while wake-after-sleep onset (WASO) tends to remain stable until the age of 60. These changes in sleep patterns are typical features of the aging process and can affect the overall quality of sleep in older individuals.

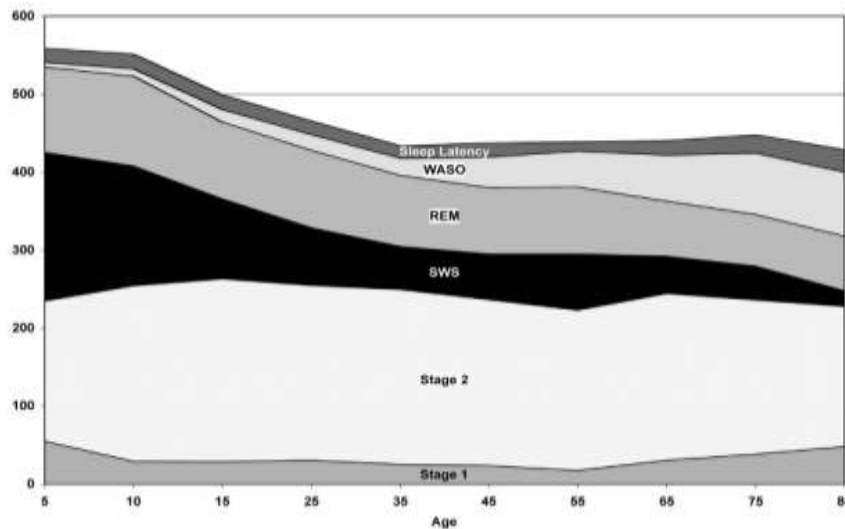


Figure 1. Changes in Sleep Architecture during Aging

In general, sleep disorders in the elderly are categorized into primary sleep disorders, such as sleep-related breathing disorders (SRBD) including obstructive sleep apnea (OSA), restless leg syndrome or PLMS (periodic limb movements in sleep), and REM sleep behavior disorder (RBD). Sleep-related breathing disorders in the elderly can start with symptoms like snoring and progress to obstructive sleep apnea (OSA).

Breathing disturbances during sleep can involve conditions like apnea or hypopnea, where OSA is diagnosed if apnea or hypopnea events last for more than 10 seconds per night, accompanied by a recovery of consciousness and nocturnal hypoxemia. An Apnea-Hypopnea Index (AHI) value of 5-10 confirms the diagnosis of Sleep-Related Breathing Disorders (SRBD). Several risk factors closely

associated with Sleep-Related Breathing Disorders (SRBD) include advanced age, male gender, obesity, and metabolic diseases. Elderly individuals experiencing sleep-related breathing disorders (SRBD) symptoms are often accompanied by insomnia. [5] Insomnia is a contributing factor that can worsen neurodegenerative conditions such as Parkinson's and dementia. Snoring is another sleep disorder that can occur in the elderly, often caused by anatomical changes in the respiratory tract, and metabolic diseases, and can lead to insomnia in patients with breathing disturbances during sleep. The effects of changes in sleep patterns in older age can result in decreased blood

pressure, reduced heart rate during both NREM and REM sleep, episodic arrhythmias during REM sleep, regular respiration during NREM sleep, and irregular respiration during REM sleep, decreased thermoregulatory responses to heat and cold during NREM sleep, and the disappearance of thermoregulatory responses during REM sleep. Natural changes related to circadian rhythms can lead to alterations in sleep timing in older individuals, causing them to go to bed earlier and wake up earlier. Additionally, melatonin levels are said to decrease in older age, affecting the circadian rhythm. [6]

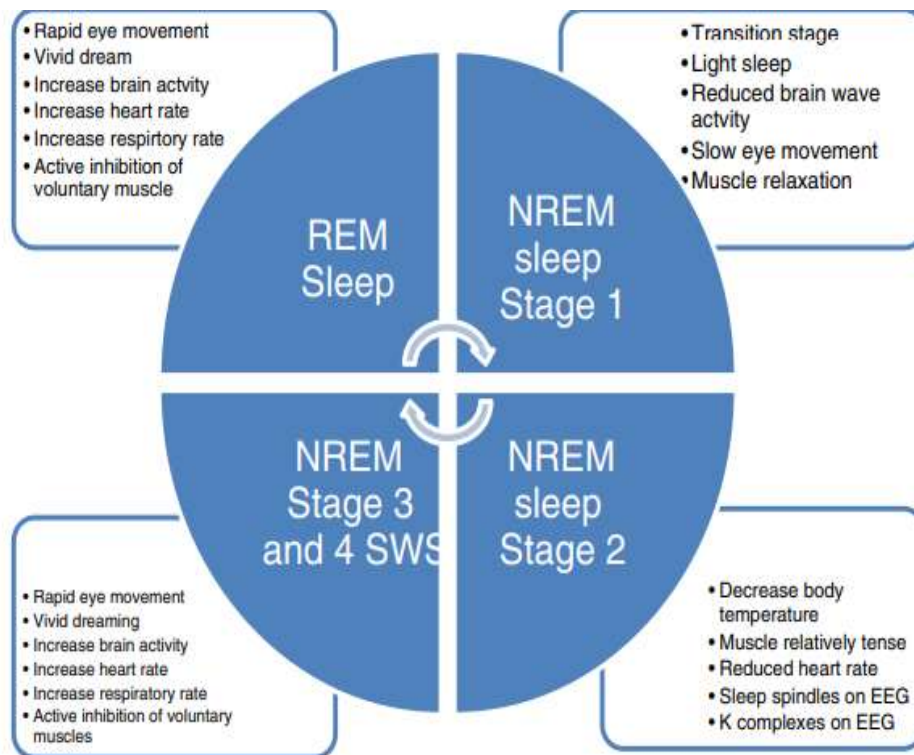


Figure 2. Changes in the Sleep Process in Older Age

### Insomnia in Elderly

Insomnia is a condition characterized by difficulties in initiating, maintaining, and achieving the desired duration and quality of sleep, leading to disturbances in daily activities despite a conducive sleep environment. According to ICSD III (International Classification of Sleep

Disorders), insomnia is divided into three subtypes:

- Short-term insomnia, also known as acute insomnia, is usually related to stress factors and occurs for a period of less than 3 months.
- Chronic insomnia involves symptoms occurring at least 3 nights per week and lasting for at least 3 months or more. It

does not include conditions of insufficient sleep time or other sleep disorders.

- Other types of insomnia represent conditions that combine both acute and chronic elements.

Insomnia has a significant impact on older individuals and may even lead to depression. Factors contributing to insomnia in the elderly include biological and physical changes as well as social influences. Untreated insomnia can lead to morbidity in older patients. Treatment for insomnia can involve non-pharmacological therapies such as sleep hygiene, cognitive-behavioral therapy (CBT), sleep restriction, and relaxation techniques. Pharmacological treatment options may include antidepressants, melatonin receptor agonists, and orexin receptor antagonists.

### **Sleep-Related Breathing Disorders**

Elderly patients experiencing Obstructive Sleep Apnea (OSA) are often affected by anatomical changes and medical conditions. Older individuals with complaints of insomnia may also have OSA, so, during sleep disorder screening, it is important to inquire about their ability to maintain sleep and their surrounding environment. Patients with OSA commonly have comorbid conditions such as hypertension, diabetes mellitus, and obesity. Diagnosis can be established through polysomnography and calculation of the apnea-hypopnea index. Treatment for sleep disorders like OSA may involve Continuous Positive Airway Pressure (CPAP) therapy, weight loss, and anatomical structure reconstruction or surgery, which is considered to be contributing to OSA (Obstructive sleep apnea).<sup>[7]</sup>

### **Restless Leg Syndrome (RLS)**

Restless Leg Syndrome (RLS) is a movement disorder characterized by uncomfortable sensations in the legs, leading to the urge to move them, particularly during the nighttime. Elderly patients experiencing this condition often

feel drowsy during the day, and if left untreated, it can cause psychological disturbances and increase morbidity in older individuals. Low serum ferritin levels can also be a risk factor for Restless Leg Syndrome (RLS). Therapeutic approaches for RLS in elderly patients include iron supplementation, evaluating and addressing chronic conditions that may affect serum ferritin levels, and administering medications such as dopamine agonists, levodopa with alpha-2 delta calcium channel ligands. However, the use of opioids and benzodiazepines is not recommended for elderly patients with RLS.

### **REM Sleep Behavioural Disorder (RBD)**

The described condition is known as parasomnia, with a characteristic feature of experiencing paralysis during REM sleep, which can manifest as movements within dreams. Another notable symptom is the vivid recall of unpleasant dreams. This complaint can occur between the ages of 50 and 58, but it may also be observed at ages 40 and 80. Currently, the diagnosis of REM Sleep Behavior Disorder (RBD) is confirmed using polysomnography, and management typically involves the use of medications such as clonazepam and melatonin. Several other medical conditions can cause sleep disturbances in older individuals, including heart disorders, chronic respiratory issues, pain, Gastroesophageal Reflux Disease (GERD), nocturia (frequent urination at night), Parkinson's disease, and dementia. These conditions need to be considered and addressed in the management of sleep disturbances in the elderly.

### **Sleep and Cognitive Impairment**

The most commonly encountered cognitive impairment is mild cognitive impairment (MCI), also known as Mild Cognitive Impairment. The increasing number of dementia patients has led to more frequent cognitive function screenings. Based on a cohort study conducted in America, the

duration of sleep has been found to play a significant role in the occurrence of dementia. Executive function is the highest cognitive domain of an individual. Adequate sleep, lasting at least six hours, is said to help preserve executive function in older individuals.<sup>[8]</sup> Sleep and memory are closely related to each other. Sufficient sleep can facilitate memory consolidation processes in the brain. The relationship between sleep and an individual's memory lies in neuronal activity during sleep. The hippocampus plays a crucial role in memory transfer and is also associated with producing neurotransmitters for sleep. The hippocampus is particularly involved in episodic memory, but this connection is still a subject of ongoing research. Numerous studies have discussed the association between sleep, circadian rhythms, dementia prevalence, and cognitive decline, but the research is still ongoing. In the preclinical stage of Alzheimer's dementia, the deposition of amyloid plaques in the cerebrospinal fluid can impact an individual's sleep. Parkinson's disease and Lewy body dementia may lead to sleep disturbances such as hypersomnia and nocturnal parasomnia.<sup>[9]</sup> Genetic studies have also made new discoveries related to sleep disorders, such as BMAL1, CRY1, and PER1 genes in the cingulate cortex, striatum nucleus, and pineal gland. Sleep disorders are not only influenced by genetics but also by hormones and the overall health conditions of older individuals. Neuropsychiatric symptoms that appear in dementia patients are also influenced by sleep duration and latency. The sleep process and sleep disorders play a significant role in neurodegenerative diseases, as neurodegenerative diseases can exacerbate sleep complaints, and sleep disorders can increase the morbidity of these conditions. Menopausal women may experience disrupted sleep due to hormonal changes. The prevalence and growth rate of dementia reach 5-10% per year in individuals aged 65 and above and increase even further in those aged 90 years.

Changes in motor skills, side effects of medications, depression, autonomic disorders, pain, and other factors also contribute to sleep disturbances in older individuals. Other research suggests that improving sleep timing, duration, and circadian rhythm can delay the onset of neurodegenerative diseases.<sup>[10]</sup> Sleep disturbances commonly experienced by patients with dementia and Parkinson's disease are insomnia and REM Sleep Behavior Disorder (RBD). About 60% of dementia patients experience sleep-related breathing disorders during sleep, and 50% suffer from insomnia. In patients with Lewy Body Dementia, 90% are diagnosed with REM Sleep Behavior Disorder (RBD) and insomnia. Patients with dementia often exhibit irregular sleep-wake rhythm disorder (ISWRD), where their circadian rhythm does not align with the typical wake-sleep cycle, leading to fragmented sleep patterns throughout the day and night. Medications used to treat dementia can also have side effects on sleep. The use of antidepressants is said to increase the incidence of primary and secondary RBD (REM Sleep Behavior Disorder). The circadian system plays a crucial role in sleep disturbances. Circadian rhythms act as an internal biological clock for an individual, regulating diurnal and nocturnal phases, and are sensitive to external light and glutaminergic activity. Circadian rhythms also influence the relationship between the environment and feedback from neuromolecular processes. Three genes that play a role in sleep regulation are Period (Per1, Per2, and Per3), Cryptochrome (Cry1 and Cry2), Bmal1, and Clock.<sup>[11]</sup> Dementia with amyloid-beta (A $\beta$ ) protein accumulation is believed to impact the sleep cycle, as A $\beta$  binds to neuronal and non-neuronal components in the plasma membrane, leading to synaptic dysfunction and loss. Older individuals with normal cognitive function but short or long sleep durations (over seven hours) have shown a link to the decline in frontotemporal gray matter function over an eight-year period. Other research indicates a relationship

between sleep quality and cortical atrophy, where reduced sleep time can accelerate neurodegenerative processes, as demonstrated in animal studies. The locus coeruleus, an area in the brain responsible for sleep quality and cognitive function, shows a decrease in the number of neurons with age and its projections to the prefrontal cortex.

### Diagnosing Sleep Disorders

The diagnosis of sleep disorders can be established through a step-by-step approach that includes taking a patient's medical history (anamnesis), conducting a physical examination, and performing sleep disorder screening. Below are the steps for diagnosing sleep disorders in older adults:

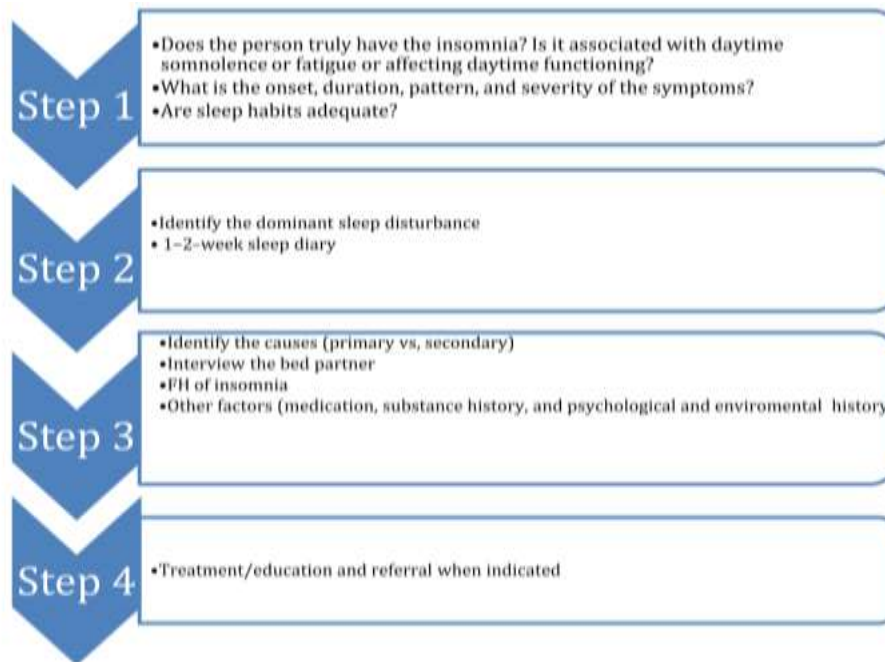


Figure 3. Diagnosing Sleep Disorders

Therapies for sleep disorders in older adults include both pharmacological and non-pharmacological approaches. The choice of therapy depends on the patient's specific complaints and psychosocial condition. For older adults with multiple comorbidities, polypharmacy is generally discouraged, and focusing on improving sleep hygiene and environmental conditions is preferable first. Screening can be performed to assess sleep quality, sleep latency, and other disturbances such as sleep apnea. For older adults with degenerative diseases like dementia and Parkinson's, it is highly recommended to have sufficient sleep duration, preferably more than six hours per day.<sup>[10]</sup> Physical exercise, such as engaging in sports three times a week, can

significantly improve sleep duration and enhance the immune system of older adults with degenerative conditions.<sup>[6]</sup>

### Algorithm for Managing Sleep Disorders

Pharmacological therapy that can be given to older adults with insomnia sleep disorders includes trazodone, with the administration of antidepressants and antipsychotics like risperidone, particularly in dementia cases.<sup>[7,13]</sup> The administration of melatonin is also said to improve the sleep quality of older adults, as melatonin acts as a chronobiotic agent that plays a role in circadian rhythm. Other therapy options may include CPAP (Continuous Positive Airway Pressure) for patients with sleep disorders related to obstructive sleep apnea (OSA).

**Table 1. Synopsis of common sleep disorder diagnoses and management in the older patient.**

Table 3. Synopsis of common sleep disorder diagnoses and management in the older patient.

Sleep Disorder	Diagnosis	Non-Pharmacological Options	Pharmacological Options
Insomnia	<ul style="list-style-type: none"> <li>Clinical history</li> <li>Sleep questionnaires/ tools and PSG are supportive</li> </ul>	<ul style="list-style-type: none"> <li>CBT-I</li> <li>dCBT-I</li> <li>SHE</li> <li>Relaxation</li> <li>Mindfulness</li> </ul>	<ul style="list-style-type: none"> <li>Second-line/short-term</li> <li>Dependent on patient</li> </ul>
Sleep Disordered Breathing	<ul style="list-style-type: none"> <li>PSG</li> <li>Portable home-based devices</li> </ul>	<ul style="list-style-type: none"> <li>PAP</li> <li>Weight loss where appropriate</li> </ul>	<ul style="list-style-type: none"> <li>Consider reduction in sedating medications</li> </ul>
Restless Leg Syndrome	<ul style="list-style-type: none"> <li>Clinical history</li> <li>Screening question may be helpful</li> </ul>	<ul style="list-style-type: none"> <li>Limited evidence</li> </ul>	<ul style="list-style-type: none"> <li>Iron replacement in deficiency</li> <li>Dopamine agonists</li> <li>Alpha-2 delta calcium channel ligands</li> <li>Levodopa</li> <li>Benzodiazepines and opioids with caution</li> </ul>
REM sleep behaviour disorder	<ul style="list-style-type: none"> <li>PSG</li> <li>Screening question and collateral may be helpful</li> </ul>	<ul style="list-style-type: none"> <li>Modifying sleeping environment if concerns for injury</li> </ul>	<ul style="list-style-type: none"> <li>Review for potential exacerbating medications</li> <li>Limited evidence for melatonin and clonazepam</li> <li>Consider potential exacerbating medications</li> </ul>

CBT-I = cognitive behavioural therapy for insomnia, dCBT-I = digital cognitive behavioural therapy for insomnia, PAP = positive airway pressure therapy, PSG = polysomnography, SHE = sleep hygiene education.

**CONCLUSION**

Sleep disturbance in the elderly is a problem that cannot be separated from physical conditions and degenerative diseases. Various pathophysiologies underlying sleep disturbances in the elderly play an important role related to the follow-up to be carried out. Clinical manifestations of sleep disorders can vary from insomnia to movement disorders during sleep. Therapy for sleep disorders is strongly influenced by the causes and co-morbidities of the patient

**Declaration by Authors**

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