



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

A Review Article on Sleep Disorders

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ARTICLE INFO

Published: 03 July 2025

Keywords:

Sleep, Sleep Disorders,
REM, NREM, Circadian
Rhythm, Parasomnia,
Insomnia

DOI:

10.5281/zenodo.15795520

ABSTRACT

Sleep is a vital neurological function that plays a crucial role in rest and restoring energy. Its significance is evident in the fact that people spend nearly one-third of their lives asleep. Alterations in sleep patterns, duration, or consistency can result in sleep disturbances, which, when persistent, negatively impact overall health and well-being. Sleep is broadly divided into two physiological and behavioral states: Non-Rapid Eye Movement (NREM) sleep—which includes four distinct stages—and Rapid Eye Movement (REM) sleep, which features muscle paralysis and a desynchronized EEG pattern. The sleep-wake cycle is controlled by the circadian rhythm, regulated by the suprachiasmatic nuclei in the hypothalamus. Common sleep-related problems include excessive daytime sleepiness, insomnia, irregular sleep behaviors, and delayed sleep onset. Diagnostic tools such as overnight polysomnography and the multiple sleep latency test are essential for identifying sleep disorders. This article will explore the epidemiology, causes, clinical features, types, diagnostic approaches, and treatment options for various sleep disorders.

INTRODUCTION

Definition Of the Sleep

Sleep is a functional state that involves a variety of physiological and behavioral processes [1]. It is distinguished by a relative unconsciousness of the outside environment, a decrease in voluntary body movement, and a general lack of memory of the state [2].

Sleep Cycle

Based on three physiological measurements electroencephalography (EEG), electrooculogram (EOG) and electromyography (EMG), sleep is categorized into two distinct states: rapid eye movement (REM) and non-rapid eye movement (NREM). The initial sleep cycle is often the shortest, lasting 70 to 100 minutes, while subsequent cycles last between 90 and 120 minutes [3].

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

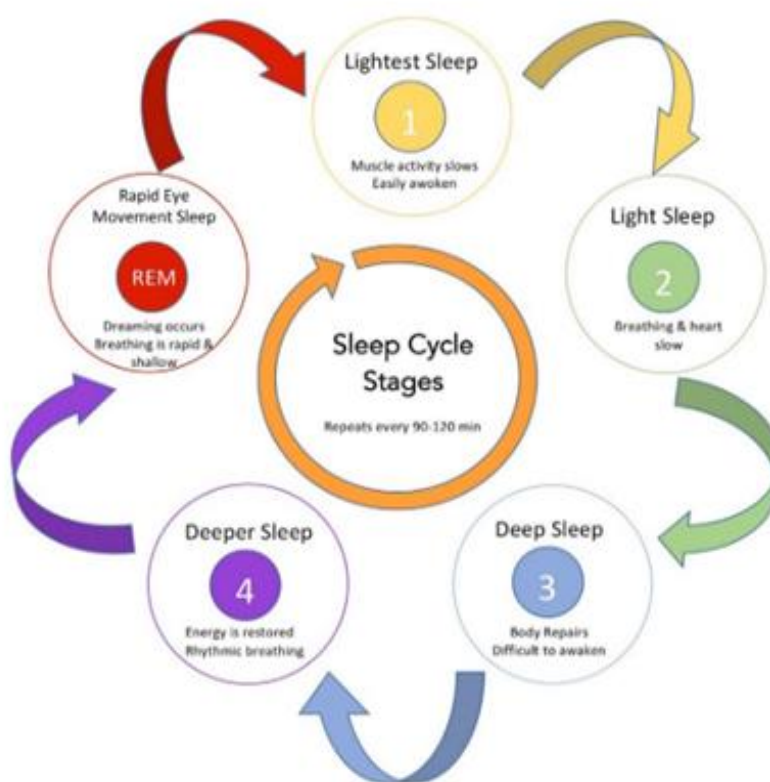


NREM Sleep Patterns: NREM sleep is composed of three different stages.

- Stage 1:** Also called N1, it is characterized by the low-voltage mixed frequency theta waves (4-8 Hz) replace the alpha rhythm of alertness.
- Stage 2:** Also called N2, it is characterized by the sleep spindles and K complexes are terms used to describe patterns on the EEG.
- Stage 3 and 4:** Also called N3, deep sleep, delta sleep or slow wave sleep. Slow-wave

sleep has a higher arousal threshold than “lighter” stages of NREM sleep [4].

REM Sleep Patterns: Dreaming occurs during the REM phase of sleep. It is distinguished by entire body voluntary muscular paralysis (with the exception of the extraocular muscles) This paralysis is hypothesized to be a mechanism that prevents neural stimuli from dreams from manifesting as actual muscle when asleep. The EEG in REM consists of ‘sawtooth waveforms,’ theta waves, and slow, alpha waves in a desynchronized pattern [5].



Physiological Chanes During Sleep

Various physiological and behavioral changes occur during normal waking, NREM sleep and REM sleep listed in (Table 1).

Table-1: Physiological Changes During Sleep

Physiological Process	During NREM	During REM
brain activity	decreases from wakefulness	increases in motor and sensory areas, while other areas are similar to NREM
heart rate	slows from wakefulness	increases and varies compared with NREM
blood pressure	decreases from wakefulness	increases (up to 30 percent) and varies from NREM
blood flow to brain	does not change from wakefulness in most regions	increases by 50 to 200 percent from NREM, depending on brain region
respiration	decreases from wakefulness	increases and varies from NREM, but may show brief stoppages (apnea); coughing suppressed
airway resistance	increases from wakefulness	increases and varies from wakefulness
body temperature	is regulated at lower set point than wakefulness; shivering initiated at lower temperature than during wakefulness	is not regulated; no shivering or sweating; temperature drifts toward that of the local environment
sexual arousal	occurs infrequently	increases from NREM (in both males and females)

Many hormones have substantial connections with sleep-wake cycles. Growth hormone secretion increases in a pulsatile manner during NREM sleep in the initial third of the typical sleep period. Prolactin secretion rises 30 to 90 minutes after sleep onset, while sleep inhibits cortisol secretion. Thyroid-stimulating hormone secretion peaks in the evening and declines throughout the night. Testosterone levels in men increase during sleep, reaching peak levels at 0800 h, with no clear link found between gonadotropic hormones and the sleep-wake cycle in children or adults. Melatonin, released by the pineal gland, peaks between 0300 h and 0500h, decreasing to low levels during the day. Body temperature to decline at sleep onset, reaching its lowest point during third sleep cycle. Penile erection and clitoral tumescence occur during REM sleep [6].

Circadian Rhythms, The 24-Hour Clock

Circadian rhythms are daily patterns in physiology and behaviour, governing sleep, activity, food intake, and regulating body functions like temperature and hormone release. These rhythms originate from neural structures in the hypothalamus, acting as a biological clock. Sleep-wake regulation involves the balance between increasing sleep drive throughout the day and circadian rhythms promoting wakefulness. As the day progresses, sleep drive rises, leading to sleep onset, while in the morning, reduced sleep drive and circadian arousal contribute to awakening [7].

Sleep Disorders

A sleep disorder, or somnopathy, is a medical condition that disrupts an individual's sleep patterns, impacting their physical, mental, social, and emotional functioning, often leading to serious



consequences for health and overall quality of life [8].

Epidemiology

- Around 30% of the population has reported experiencing sleep disturbances lasting for several nights each month [9].
- Insomnia is more common in women than men for most of their lives, with a ratio of (1.4:1.0) [10].
- RLS is more common among women than men, with a prevalence of 9.0% for women compared to 5.4% for men, across all age groups [11].
- SDB is more common in men compared to premenopausal women, with a ratio of 2:1 [12].
- In individuals without OSA, approximately 3% experience parasomnias like sleepwalking, sleep-related sexual acts, and sleep-related eating. Nightmares impact around 43.8%, and REM sleep behaviour disorder is estimated at 8.7 per 100,000 people, with a 3:1 ratio of men to women [13].
- Adolescents and young adults commonly experience DSPD, with an estimated occurrence ranging from 7% to 16%.

TYPES OF SLEEP DISORDERS

The American Academy of Sleep Medicine developed the ICSD-2 to standardize definitions and implement a systematic diagnostic approach in the realm of sleep disorders [14]. These conditions are primarily categorized in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).

→ Insomnia

Also known as sleeplessness, is a sleep disorder causing difficulty in either falling asleep or staying asleep as desired [15].

Etiology:

Heart failure, Hyperthyroidism, Heartburn, Restless leg syndrome, Psychological stress.

Symptoms:

Trouble sleeping, Depressed mood, Low energy, Daytime sleepiness.

→ Hypersomnia

It is a neurological condition characterizes by either prolonged periods of sleep or excessive drowsiness [16].

Etiology:

Parkinson's disease, Alzheimer's disease, Upper airway resistance syndrome

Symptoms:

Excessive daytime sleepiness, Sleep drunkenness [17].

→ Narcolepsy

Narcolepsy is a long-term Neurological condition characterized but difficulty in controlling sleep and wakefulness patterns.

Etiology:

Orexin deficiency, genetic factors

Symptoms:

Excessive daytime sleepiness, Involuntary sleep episodes, hallucinations [18].

→ Circadian Rhythm Sleep Disorders



CRSD refer to a group of sleep disorders that impact the timing of sleep. Also known as Circadian Rhythm Sleep Wake Disorder

Etiology:

Jet lag syndrome, Night shift work.

Symptoms:

Excessive day time sleepiness, decreased alertness [19].

→ Breathing Related Sleep Disorders

Sleep disturbances caused by breathing disorders like Obstructive or Central Sleep Apnoea or Central Alveolar Hyperventilation result in either excessive sleepiness or insomnia

Etiology:

Central Hypoventilation syndrome (When brain receptors fail to detect CO₂ level changes during sleep, causing low breathing and O₂ level.

Symptoms:

Snoring, Catathrenia [20].

→ Restless Leg Syndrome (RLS)

RLS also called to as Willis-Ekbom Disease is typically a chronic condition characterized by an intense desire to move the legs. Furthermore, numerous individuals experience limb jerking while a sleep, a condition referred to as Periodic Limb Movement.

Etiology:

Due to Iron deficiency (Anaemia), End Stage Renal Disease (ESRD), Multiple sclerosis, Diabetes, Sleep apnoea

Symptoms:

Uncomfortable sensation in the legs (sitting or lying down) [21].

Parasomnias

Parasomnias are sleep disorders involving abnormal movements, behaviours or emotions during sleep [22].

Types Of Parasomnias:

They are two types of parasomnias (NREM and REM)

NREM Parasomnias

→ Sleep walking disorder

It is also referred to as somnambulism or noctambulism. It usually happens during the initial phase of the night when slow-wave sleep is most dominant [23].

→ Night terror disorder

Also known as Sleep terror, is a sleep disorder that causes panic or anxiety and usually occurs during the initial phases of sleep [24].

Rem Parasomnias

→ REM behaviour disorder

The main characteristic of RBD is the loss of muscle atonia or hypotonia and the occurrence of different unusual movements during sleep [25].

→ Night mare disorder

Nightmares are intense and frightening dreams that happen during REM sleep, followed by waking up with vivid memory recall [26].

Diagnosis



The top two vital laboratory tests comprise polysomnography (PSG) and multiple sleep latency test (MSLT).

Polysomnography

Polysomnography (PSG), a form of sleep study, is a comprehensive analysis of sleep and a diagnostic tool in sleep medicine. It monitors various bodily functions such as brain activity (EEG), eye movements (EOG), muscle activity (EMG), and heart rhythm (ECG) [27].

Multiple sleep latency tests

The MSLT assess sleep disorder by measuring the time from nap start to sleep onset, useful for diagnosing hypersomnolence disorders like narcolepsy. It involves monitoring brain waves, muscle activity, and eye movements, typically spanning 7 hours in a day [28].

Treatment For Sleep Disorders

Treatment for sleep disorders are depend upon the particular type of sleep disorder.

Treatment for Insomnia can be divided into non-pharmacological and pharmacological treatments.

Non-pharmacological Treatment

- Cognitive -behavioural therapy for insomnia (CBT-I) comprises a collection of psychological and behavioural methods designed to address and manage sleep issues effectively. CBT-I not only greatly improves sleep metrics like sleep efficiency and total sleep duration but also decreases the time it takes to fall asleep, periods of wakefulness during the night, and the severity of insomnia [29]. In CBT-I these stages include:

- Sleep restriction therapy (SRT): SRT involves limiting the time spent in bed to boost the urge to sleep.
- Stimulus control therapy: Aims to modify sleep routines to alleviate difficulties in falling asleep. Patients are advised to only go to bed when they feel sleepy, and to reserve the bed exclusively for sleeping, avoiding activities like watching TV or reading books.
- Relaxation therapy: It involves using techniques such as meditation and deep breathing exercises before bedtime to promote relaxation and improve quality of sleep.
- Sleep hygiene: It refers to teaching people about tips on good sleep; Stick to a consistent sleep schedule, going to bed and waking up at similar times every day, incorporate regular exercise into your daily routine, avoid caffeine, alcohol before bedtime, keep your room cool and dark for optimal sleep conditions, prioritize getting enough sleep, as longer sleep durations tend to result in more REM sleep [30].

Pharmacological Treatment

- Histamine type 1 receptor blockers such as chlorpheniramine and diphenhydramine are commonly used for sleep difficulties due to their sedative effects, but their anticholinergic effects make them undesirable.
- Benzodiazepines, including flurazepam and temazepam, are commonly prescribed for insomnia. They function by enhancing neurotransmitter activity at specific sites on the GABA receptor complex, leading to changes in sleep stages.
- Non-benzodiazepine hypnotics or z-drugs such as zolpidem and zaleplon, despite having



different chemical structures, interact with the GABA-BZD receptor, including sedation for acute and short-term insomnia.

- Melatonin receptor agonists like ramelteon act on MT1 and MT2 receptors to regulate sleep-wake cycles, particularly beneficial in circadian rhythm disorders [31].
- Orexin receptor antagonists, such as suvorexant, promote sleep by blocking wakefulness-promoting orexin receptors, aiding both sleep onset and maintenance [32].

Treatment for obstructive sleep apnoea (OSA) primarily involves using positive airway therapy (PAP) devices, making lifestyle changes, and in some cases, utilizing oral appliances or surgical interventions [33]. For patients who continue to experience excessive daytime sleepiness despite proper PAP usage and resolution of breathing problems, drug treatments like solriamfetol, stimulants (such as amphetamines or modafinil), and norepinephrine reuptake inhibitors may be considered to improve wakefulness [34]. Modafinil, a non- amphetamine stimulant that enhances wakefulness, is the primary treatment choice for narcolepsy due to its ability to decrease daytime sleepiness, good tolerability, and lower potential for abuse compared to traditional stimulants like amphetamines and methylphenidate, which are used as secondary treatment. Patients experiencing significant cataplexy may find relief from medications that suppress REM, such as antidepressants and sodium oxybate. Light-phase shift therapy can help correct sleep disturbances related to circadian rhythm abnormalities by exposing patients to bright light. Gabapentin enacarbil, a prodrug of gabapentin, is effective in improving restless leg syndrome and can therefore help alleviate sleep disturbances [35].

CONCLUSION

It has a major impact on controlling both body and central nervous system processes. Daily lifestyle decisions have a big impact on how sleep is regulated. Since it promotes healing, growth, and restoration, getting enough sleep is crucial for maintaining general physical and mental health.

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HOW TO CITE: Dr. Manchineni Prasada Rao*, Dr. V Rajini, Dr. Y Narasimha Rao, L. Komalatha, A Review Article on Sleep Disorders, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 7, 448-456. <https://doi.org/10.5281/zenodo.15795520>

