

# WHAT'S NEW IN SLEEP DISORDERS? CHARACTERISTICS OF SLEEP DISORDERS ACCORDING TO ICD-11

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SUBMITTED: 25.11.2023

ACCEPTED: 20.12.2023

DOI: <https://doi.org/10.5114/ppiel.2023.136171>

## Authors' contribution:

A. Study design/planning • B. Data collection/entry • C. Data analysis/statistics • D. Data interpretation • E. Preparation of manuscript • F. Literature analysis/search • G. Funds collection

## ABSTRACT

Sleep is a key factor in daily human functioning and in maintaining good health. Various important physiological changes happen in all body systems and organs during sleep, chiefly due to functional changes in the autonomic and somatic nervous systems.

Sleep disorders are a considerable issue in contemporary societies because they can have severe implications for health and well-being. Disrupted sleep duration and abnormal sleep quality can both lead to sleep disorders. The disorders include insomnia, hypersomnia, sleep disorders in attention deficit hyperactivity disorder, sleep-wake rhythm disorders, sleepwalking, and behavioural REM sleep disorders.

This article presents the latest diagnostic criteria and general characteristics of the disorder. The latest scientific reports on sleep disorders and their consequences are also presented.

This article aims to describe the crucial significance of sleep to human life and to define sleep disorders based on the International Classification of Diseases, 11th Revision (ICD-11).

**Key words:** sleep disorders, International Classification of Diseases 11th Revision, hypersomnia, insomnia.

## INTRODUCTION

Sleep is a state of unconsciousness that is reversible and partial, allowing for regeneration and satisfying vital needs [1]. It is a physiological state that results from the body's biological needs [2]. During sleep, cognitive processes decrease in activity, metabolism and heart rate slow down, and the number of breaths decreases. The above-mentioned characteristics of sleep may be disrupted in sleep disorders [1-3].

During sleep, the state of full consciousness is deactivated, leading to a reduction in stimuli that can be analysed by the brain [3]. This period allows the nervous system to regenerate and prepare for work again. Furthermore, recent research reveals that sleep is vital for the endocrine system's proper functioning and memory consolidation [1]. It also stimulates neurons that were not active during wakefulness and activity, allowing synaptic consolidation and the maintenance of synaptic connections between nerve cells [1, 2].

The life cycle exhibits a regular sleep-wake rhythm. Daily sleep requirements vary according to individual needs and are influenced by several factors including age, health, daily activities, and emotional state [4]. Neonates and infants require a significant amount of sleep; according to guidelines, it is recommended that this group should sleep for 14-17 hours. The recommended amount of sleep varies depending on age, with children needing the most sleep at around 9-11 hours per night, and adults requiring between 7-9 hours per night. Elderly individuals generally require the least amount of sleep at around 6-7 hours per night according to recommendations [1, 2].

The sleep cycle is regulated by the intensity of light and social cues. Scientific studies conducted in people who are entirely isolated from external stimuli, such as light or other people, revealed an extension of the diurnal period to 24.2 hours [1-4]. Exposure to sunlight and artificial lighting has been found to alter this period. Similarly, environmental stimuli can

affect sleep function due to social interactions and emotional reactions resulting from contact with others. Nervous system arousal and strong emotional arousal can shorten sleep duration [3]. Therefore, it is crucial to consider these factors when conducting studies on sleep patterns.

The characteristics of sleep disorders was based on the International Classification of Diseases 11th Revision. The sleep phenomenon has been observed across all animals with a fully developed nervous system. Organisms without a brain-equivalent structure do not experience sleep, but they do exhibit periodic declines in vital activity [1-4].

The literature review was conducted using the PubMed, Google Scholar, and ResearchGate databases, with search terms including “sleep disorders” and “sleep”. Publications were searched limitlessly since 2017.

This article aims to describe the crucial significance of sleep in human life and to define sleep disorders based on ICD-11.

## STAGES OF SLEEP

Sleep is not a homogeneous state; rather, it is divided into 2 main phases [1-6]:

1. Non-rapid eye movement (NREM) sleep, also known as slow-wave sleep, during which delta waves of electrical brain activity are prominent;
2. Rapid eye movement (REM) – in this stage, dreams typically occur, and the body achieves complete relaxation. The brainstem component called the bridge has no impact on the muscles.

An average adult's sleep consists of 4 to 6 cycles of NREM and REM. The transition from NREM to REM takes place in stages that recur. Four NREM stages have been identified [5, 6].

Stage 1 refers to the initial phase of sleep, a transitional state between wakefulness and sleep where awareness of environmental stimuli diminish gradually. This stage is characterised by slow eye movements seen in EEG recording, the disappearance of alpha waves, and the prevalence of waves ranging from 2 to 7 Hz frequency with an amplitude of no more than 75  $\mu$ V.

Stage 2 is shallow sleep marked by an unresponsive state to environmental stimuli and sleep spindles and K complexes.

Stage 3 of sleep is referred to as slow-wave sleep. During a polysomnographic examination, waves with a frequency of 2 Hz or slower and an amplitude greater than or equal to 75  $\mu$ V occupy 20-50% of the time.

Stage 4, also known as deep sleep, is characterised by a decrease in blood pressure, metabolic processes, and heart rate. More than 50% of the waves present during this stage are slow and have an amplitude of above 75  $\mu$ V.

The sleep cycle initiates with the NREM phase, which lasts approximately 70-120 minutes. Following the 4 NREM stages, a much shorter phase of REM sleep can be observed, which usually lasts around 15-20 minutes [5, 6].

The requirement for sleep reduces with increasing age, resulting in a shorter duration of sleep. The quantity of NREM/REM cycles adapts in the following manner:

- in youthful individuals: 5 cycles,
- post 50 years of age: 4 cycles,
- post 65 years of age: 3 cycles.

## THE SIGNIFICANCE OF SLEEP

Research indicates that humans spend approximately one-third of their lives sleeping [1-3], highlighting the importance of this activity for human functioning. The theory of homeostatic sleep regulation supports this belief, suggesting that after an insufficient amount of nightly rest, taking a break is necessary to maintain normal functioning [7]. Moreover, sleep plays a crucial role in memory retention and effective brain performance. Sufficient sleep is imperative to strengthen recent memory storage for recall in the future. Furthermore, studies confirm that sleep is integral to eye-hand coordination, and causal and abstract cognition [7, 8]. A fluid structure and clear progressions with causal links are essential; attention relies on it for proper function, especially focusing, selectivity, and metastability. The quality and quantity of sleep impact the efficiency of information processing, encoding, and decoding, as well as the acquisition of new verbal and auditory skills [7, 8]. Research conducted among schoolchildren demonstrates a positive correlation between adherence to sleep time recommendations and better academic performance and mood [7, 8]. In addition, sleep aids in the regenerative processes and promotes proper hormonal functioning. Hormones such as melatonin, cortisol, and growth hormone are secreted during sleep. These crucial compounds are responsible for the proper physiological performance of the reproductive system, circadian regulation, and overall growth and development. Objective scientific studies have also highlighted specific adaptive roles of sleep, stemming from the course of evolution. Several hypotheses suggest that sleep primarily serves to replenish energy reserves previously depleted during activity [7, 8]. To optimise energy recovery, the body slows essential processes and decreases the analysis of brain stimuli. Additional studies propose that nocturnal sleep is an adaptive behaviour as a protection mechanism against predators. It has been demonstrated that individuals instinctively select a safe sleeping location to lower the possibility of predator attack and prevent harm to their well-being [7, 8].

## SLEEP DISORDERS: DEFINITION AND OVERVIEW

Sleep disorders are a frequent complaint amongst patients seeking medical attention [9]. They may occur in an episodic manner, as isolated incidents, or they may be chronic in nature. Episodes of difficulty in falling asleep, nocturnal awakening, increased sleepiness, nightmares, and so on may also take a chronic form [10].

Approximately 20% of the adult population experiences some type of sleep disorder, presenting with a variety of symptoms [9, 11], and the frequency increases in certain chronic conditions, such as depression, schizophrenia, anxiety disorders, Parkinson's disease, Alzheimer's disease, thyroid disease, diabetes, and pain syndromes of various origins [12, 13]. Repeated episodes of sleep disturbance negatively affect a person's daytime functioning. The effect of sleep disorders on mental well-being has been well documented [9-13].

Sleep disorders are defined as a collection of conditions characterised by impaired sleep quantity or quality [11].

There are 2 distinct categories of sleep disorders [14]:

1. **Dyssomnias** are sleep disorders that are characterised by abnormalities in sleep quality, duration, or quantity. It is important to recognise the presence of these disorders in individuals so that appropriate treatment can be provided. Some examples of dyssomnias include insomnia, excessive sleepiness, narcolepsy, and sleep-wake rhythm disorders, including sudden time zone change syndrome, accelerated sleep phase syndrome, and delayed sleep phase syndrome;
2. **Parasomnias**, which are disorders characterised by abnormal or maladaptive behaviour during sleep or on awakening:
  - night terrors,
  - sleep intoxication,
  - somnambulism,
  - nightmares,
  - catathrenia.

According to the latest International Statistical Classification of Diseases and Related Health Problems, version 11 (ICD-11) [15], which is not yet implemented in Poland, the chapter on 'Sleep and wakefulness disorders' comprehensively describes sleep disorders with a focus on the interplay between behavioural, psychological, and physical factors. The ICD-11 [15] includes the following sleep disorders:

- insomnia,
- sleep disorders in attention deficit hyperactivity disorder,
- hypersomnia,
- sleep-disordered breathing,
- disruption of circadian sleep patterns,

- parasomnia,
- disturbances in the rhythms of sleep and wakefulness,
- certain specific sleep disorders.

## CHARACTERISTICS OF SLEEP DISORDERS

### Insomnia

Insomnia is a disorder characterised by recurrent insufficient or low-quality sleep, which can cause stress, anxiety, and decreased quality of life [10-15]. One may experience difficulty falling asleep, which can result in a prolonged time to fall asleep after lying down. Insomnia is characterised by difficulty falling asleep, maintaining sleep (frequent night awakenings), waking early, and inability to fall back asleep. This disorder is accompanied by a sense of unrefreshing sleep or severe fatigue in the early morning hours [12, 13].

Transient, short-term (acute) insomnia can be differentiated from chronic insomnia based on the duration. Chronic insomnia is a medical condition characterised by difficulty falling or staying asleep that lasts for more than one month [14].

Transient insomnia, on the other hand, is typically related to significant life events that cause severe situational stress from the individual's perspective, such as weddings, job interviews, and emotional problems [11, 14]. This condition typically lasts for several days or up to a few weeks. It typically diminishes within several days after the tense scenario is resolved [9, 14].

Short-term (acute) insomnia typically results from experiencing a severe and stressful situation, such as the loss of a loved one, financial difficulties, the diagnosis of a serious illness affecting oneself or close ones, or forced changes in employment or residence [14]. It can last for up to 3 months and commonly resolves without requiring specialist intervention [10, 14].

Chronic insomnia is indicated by struggles falling asleep, waking up early, or experiencing awakenings during the night [10-14]. Diagnostic criteria require these difficulties to occur for at least 3 nights each week and to persist for longer than 3 months [14, 15]. This is a persistent condition that can extend over time. Specialised assistance is necessary due to a substantial decrease in the patient's quality of life [9-12].

A thorough diagnosis, including differential diagnosis, is required because insomnia is typically a secondary problem associated with other disorders, including somatic and/or psychiatric conditions [3-14].

The aetiology and pathogenesis of insomnia are linked to cognitive, emotional, and physiological factors [14]. The cognitive theory indicates an overstimulation of cognitive processes during the evening and

night periods, leading to a greater awareness of environmental stimuli.

This is correlated with an emotional response, which assigns a specific emotional value to perceived signals [14]. The enhanced sensory perception and over-interpretation of cues further reinforce this relationship. Sensory input may evoke feelings of unease and a sense of potential danger. An identifiable behaviour corresponding to this reaction is a repetitive monitoring of the clock and the time remaining until the start of the morning activity. This scenario leads to both cognitive and emotional arousal [9-14].

Repeated analysis of the diminishing amount of sleep time can lead to morning fatigue-related anxiety, which, in turn, exacerbates the difficulty of falling asleep [9-14].

The accurate diagnosis of insomnia necessitates an exhaustive examination of medical history supplemented by appropriate investigative procedures. Daytime and nighttime symptoms should be evaluated [10].

Mental and physical health evaluations of the patient are imperative [9]. Information regarding the duration, intensity, and onset of symptoms should be gathered. A thorough assessment should be conducted to determine whether the disorder is linked to environmental or medical factors [10, 16]. The baseline interview comprises questions related to activities and habits before sleeping (evaluation of physical activity, intake of stimulants). Recording sleep diaries can help in understanding sleep patterns and identifying factors that may be contributing to sleep difficulties. These diaries typically include information about bedtime routine, bedtime, and the time taken to fall asleep, as well as nocturnal awakenings and their duration, and any daytime naps [9, 10, 16]. Utilising cognitive-behavioural therapy techniques can aid in improving sleep quality. The patient can be requested to maintain a sleep diary in which they record all occurrences pertinent to insomnia symptoms [16]. A comprehensive evaluation of internal medicine is also imperative, with special attention paid to the possibility of chronicity. Diseases such as hyperthyroidism, cardiovascular disorders, and respiratory or gastrointestinal diseases should be considered [10, 16]. Furthermore, it is important to evaluate the potential side effects of medications and conduct a psychiatric assessment [17]. During the physical examination, basic vital functions should be assessed along with the size of the tongue and palatine tonsils, as well as the presence of obesity or mandibular hypoplasia [9, 16, 17]. Further investigations may include polysomnography, multiple sleep latency test, and wakefulness evaluation. Maintenance test, actigraphy, and 24-hour electroencephalography recording have been conducted [16, 17].

## Sleep disorders in attention deficit hyperactivity disorder

Attention deficit hyperactivity disorder (ADHD) is a neuropsychiatric disorder that presents a major medical concern [18, 19].

It is commonly diagnosed in early childhood, although there has been a recent increase in *de novo* diagnoses in adults. Axial symptoms of this disorder comprise attention deficits of various severities and a high susceptibility to distractors [19]. Additionally, excessive behavioural and verbal tendencies may also be present. Impulsivity and psychomotor agitation are characteristic symptoms of attention deficit hyperactivity disorder. Statistics indicate that ADHD affects roughly 5-12% of school-aged children, with a significantly higher prevalence among boys [3, 18].

This syndrome is often accompanied by sleep disorders, which pose a particular concern [3, 18, 19]. The initiation of sleep (approx. 25% of children with ADHD) and sleep maintenance (approx. 50% of children with ADHD) are crucial processes [3, 19]. Additionally, research indicates that sleep disorders pose a significant challenge to adults with ADHD, affecting around 40% of patients [18, 19].

There is evidence of bidirectional relationships between ADHD and sleep disorders, although the current literature does not provide a comprehensive understanding of them. Common sleep disorders in those with ADHD include sleep-disordered breathing, delayed sleep phase syndrome, periodic limb movements in sleep, and snoring [18, 19]. Research has shown that individuals with ADHD experience worse symptoms when they have trouble falling asleep or staying asleep through the night [19]. Attention should also be given to the symptom pattern shared by both sleep disorders and ADHD, which includes irritability, impulsivity, and impaired attention function [3, 18-20]. However, it is important to remember that irritability or attention problems are not specific symptoms and can also be seen in depressive episodes, substance abuse, substance dependence, and cognitive impairment, including dementia [16, 18-20].

This highlights the importance of conducting a differential diagnosis and implementing suitable treatment.

## Hypersomnia

Hypersomnia is a condition marked by recurrent incidents of extreme daytime sleepiness [9]. According to diagnostic criteria, the condition can be diagnosed if prolonged episodes of sleep or daytime sleep occur most days of the week for at least one month [21]. The condition cannot be accounted for by prior insomnia, insufficient sleep duration, or any other associated disorders [21, 22]. It invariably leads to sig-



nificant distress, which impedes on the individual's ability to engage in social, familial, and occupational activities. The patient experiences a depletion of essential energy, leading to a decline in the standard of activities undertaken [22].

Anxiety and restlessness frequently accompany this condition. Concerns arise that the patient may incur fatigue and lethargy during professional engagements. The patient fears that fatigue and lethargy will occur at the time of professional or social activity, which can induce feelings of shame and lack of control over one's life [21, 22]. Other symptoms include irritability, annoyance, psychomotor slowing, slow speech, difficulty focusing on tasks, as well as disorders of selective and metastatic attention. In rare instances, the symptoms may progress to more severe conditions. Especially among individuals attempting to sustain their prior activity despite tiredness and drowsiness, there may exist the production of symptoms through hallucinations. Research also highlights an enhanced sense of smell and heightened susceptibility to odours [21, 22].

Hypersomnia is a varied and complex condition that involves both autonomic dysfunction and cognitive complaints. Lethargy is the principal feature, but symptoms are not restricted to excessive sleepiness alone. Individuals with hypersomnia also experience difficulty with sleep inertia, fatigue, and a propensity towards an evening chronotype. During sleep inertia, there is a tendency to stay asleep despite attempts to wake up. This can result in awakening that varies from effortless with promptness to get out of bed, to arduous and lengthy. This leads to feelings of disorientation, impaired motor coordination, sluggishness, and frequent agitation [23-25]. The physical weight of hypersomnia symptoms results in a decline in health-related quality of life, reduced functioning across various domains, poorer daily performance, and an adverse effect on overall health [26].

### Sleep-disordered breathing

A specific type of sleeping disorder is a result of respiratory disorders, such as central sleep apnoea, obstructive syndrome, or alveolar hyperventilation syndrome [9, 27, 28].

The disorder presents contradictory conditions: excessive sleepiness or insomnia. According to the diagnostic criteria, this disorder results from structural and functional disorders of the respiratory system. Respiratory conditions that are not induced by substances such as alcohol, drugs, or narcotics, or any other somatic or psychiatric disorders can negatively impact sleep quality [27, 28].

Estimates suggest that sleep disorders related to respiratory issues are prevalent. This, in turn, affects the patient's daytime functionality [27]. Respi-

ratory disorders affect around 10-40% of paediatric patients and 20-45% of adult patients. Sleep apnoea is a significant issue within this group of conditions and is characterised by the airway's airflow coming to a complete stop for more than 10 seconds [9, 27, 28]. Poor sleep quality not only affects sleep patterns but also increases the risk of certain somatic diseases, such as cardiovascular incidents [28, 29]. It is important to note that these conditions significantly increase the risk of dangerous vascular events, including stroke and heart attack. If left untreated, they can increase the risk of sudden cardiac death. In addition, sleep-disordered breathing has been shown to promote morning tiredness, and difficulty in focusing attention and coordinating complex cognitive processes. Shortness of breath is a similar condition, defined as a non-physiological respiratory event lasting longer than 10 seconds, associated with a reduction in chest movement (by at least 30%) or airflow. Diagnostic and treatment protocols should be put in place for these conditions [9, 24, 28].

### Disorders of circadian rhythm of sleep

Disturbances of circadian rhythms of sleep and wakefulness are linked to an abnormal sleep-wake cycle [30]. Such disturbances can lead to a range of symptoms, including insomnia, excessive sleepiness, or alternating between the 2 states [30]. Certain factors can favour the onset of this disorder, including a mismatch between the endogenous circadian rhythm and the external environment and an abnormal regulation of the same [30, 31]. This disorder is identified by the inability to fall asleep until the early morning hours and functional difficulties occurring late at night. In the morning or early afternoon, individuals may experience advanced sleep phase syndrome, whereby they fall asleep early, typically between 6 p.m. and 9 p.m., and awaken early, usually between 1:00 and 3:00 [9, 30, 31].

The sleep-wake cycle's timing and structure are shaped by the diurnal rhythm and sleep homeostasis. The incidence of disrupted circadian rhythm in sleep varies with age and can be due to biological or behavioural factors. Genetically determined differences in circadian rhythm processes and psychological phenomena, including individual differences in sleep and wakefulness times, as well as the likelihood of sleep disorders, are influenced by mindfulness and anxiety. Disrupted diurnal rhythms result from intrinsic, environmental or behavioural, and social causes, such as shift work or fatigue caused by changes in time zones. Sleep deprivation results in subjective and objective effects. Sleepiness and reduced attention are common symptoms, with higher cognitive functions being better preserved but at the expense of increased effort. Complaints related to disturbed cir-

adian rhythms of sleep and wakefulness are chronic and can result in difficulties with both falling asleep and maintaining wakefulness. This leads to significant suffering and impairment of daily functioning [32, 33].

## Parasomnias

Parasomnias are problematic physiological or behavioural events that occur during the process of falling asleep, while asleep, or upon waking up from sleep [9]. Parasomnias can happen during either non-rapid eye movement (NREM) sleep, rapid eye movement (REM) sleep, or during transitions in and out of sleep. They consist of an array of sleep-related abnormal complex movements, behaviours, emotions, perceptions, dreams, and autonomic nervous system activity [34, 35].

This group of disorders encompasses:

1. Sleepwalking (somnambulism) – moving and shifting during sleep. It typically manifests around the age of 5 years, peaking at age 12 years, and tends to resolve naturally by age 15 years. The precise causes of this behaviour are still not fully understood. Some scholars associate sleepwalking with the appearance of vivid dreams and imagery during sleep. This can lead to particular behaviours, such as attempting to flee or protect oneself from perceived threats [9, 34]. Additionally, the occurrence of violent and potentially dangerous behaviour during REM behavioural sleep disorder is worth noting.
2. Behavioural REM sleep disorder – harmful behaviours during sleep, characterised by sleep disruption and excessive motor activity, have been identified. The most common behaviours associated with this disorder include kicking, waving hands, hitting with fists, and making uncoordinated movements. These actions significantly increase the risk of falling out of bed and injuring oneself by hitting walls or furniture [9, 29]. It has been proven that the basis of this disorder lies in the presence of threatening dream motifs, like attacks from the environment and the need for self-defence. The disorder is typically idiopathic and not linked to daily life events; however, some cases have been reported. The disorder is described as being secondary in nature and can manifest as a single episode that is transient, or chronically [9, 29]. The chronic nature of REM behavioural sleep disorder typically presents in patients who suffer from neurological diseases (Parkinson's disease, amyotrophic lateral sclerosis, Tourette's syndrome), cancer, etc. Individuals with vascular diseases such as subarachnoid haemorrhage and vasculitis, as well as those taking specific medications like tricyclic antidepressants, may be at an increased risk [9, 35].

## CONCLUSIONS

Validating individual sleep disorders in line with the ICD-11 classification using insightful characteristics and accurate diagnosis will enable the implementation of suitably tailored therapy. This categorisation proves to be an indispensable clinical tool for specialists. It is therefore advisable to continuously increase knowledge in this area and to be aware that the quality of sleep has a significant impact on all aspects of life.

### Disclosure

The authors declare no conflict of interest.

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