Mini Review



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Sleep Health and Sleep Hygiene – Revisited

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Abstract

Sleep is essential to maintain physical, mental and emotional health. The uncertainties about sleeping habits among the general population remains distinctly high. Multiple factors, both physiological and pathological affect sleep, and sleep disturbances inturn affects overall health and performance. Sleep is staged into REM and NREM, each required to restore physiological stability and enhance memory consolidation, immune system reinforcement, etc. Various hormones like melatonin, cortisol, growth hormone, Leptin, Ghrelin, Insulin, Testosterone, TSH have circadian rhythm which is altered with disturbed sleep cycle, thus affecting overall metabolic health. Healthy sleep promoting strategies have been addressed. Also, short term and long-term ill effects of altered sleep cycle are put forth. The concept of power nap, sleep inertia, sleep hygiene concepts as part of our everyday routine activity need better understanding. Lastly the right amount of exercise, relaxation techniques, food and beverages which promote sleep will help in acquiring a sound and stable sleep on regular basis. Few sleep habit essentials for shift workers can help improve their health outcomes.

Adequate sleep is a fundamental component of good health, playing a vital role in maintaining physical, mental, and emotional well-being. Despite its importance, many people still face challenges when it comes to understanding and establishing healthy sleep habits. A variety of factors, both physiological and pathological, can impact the quality of sleep, and when sleep is disturbed, it can lead to a wide range of health problems and decreased daily functioning. Sleep plays a crucial role in maintaining overall physical, mental, and emotional well-being. However, there remains a significant amount of uncertainty surrounding healthy sleep habits among the general population. Sleep can be categorized into two main stages: Rapid Eye Movement (REM) and Non-Rapid Eye Movement (NREM). Each of these stages is vital for restoring physiological stability and enhancing key processes such as memory consolidation, immune system function, and tissue repair. A variety of hormones, including melatonin, cortisol, growth hormone, leptin, ghrelin, insulin, testosterone, and thyroid-stimulating hormone (TSH), are all regulated by the body's circadian rhythm, which can be disrupted by an irregular sleep cycle. This disruption can negatively impact metabolic health and increase the risk of various chronic conditions. To promote healthy sleep, it is essential to implement strategies that encourage better sleep hygiene, such as maintaining consistent sleep schedules and creating a calming pre-sleep routine. Moreover, the short-term and long-term consequences of sleep cycle disturbances should not be overlooked. These can range from decreased cognitive

function and mood disturbances to more severe health problems such as cardiovascular diseases and metabolic disorders. Concepts such as power naps, sleep inertia (the grogginess felt after waking up), and sleep hygiene are vital to improving our understanding of how sleep affects our daily routines. Proper knowledge of these topics can lead to better sleep quality.

In addition, incorporating regular physical activity, practicing relaxation techniques, and making mindful dietary choices-such as avoiding caffeine or heavy meals before bed-can significantly enhance sleep quality. It is also important to recognize the unique sleep needs of shift workers, who may experience altered sleep cycles, and adopt strategies tailored to their specific situation to improve their overall health and well-being.

Keywords: Mental Health; Sleep; Sleep Hygiene; Leptin; Ghrelin; Insulin

Abbreviations

REM: Rapid Eye Movement; NREM: Non-Rapid Eye Movement; TSH: Thyroid-Stimulating Hormone.

Introduction

Sleep is a transient state of unconsciousness from which an individual can be awakened by sensory or other stimuli. Neurologically, sleep initiation and maintenance is an active process and involves the ascending reticular system and preoptic areas along with others [1]. There is also a circadian clock, seat being suprachiasmatic nucleus of hypothalamus, which is driven endogenously and has a 24hour cycle. This clock is controlled by both internal and external (Zeitgbers) factors [2,3]. Behaviourally, sleep is characterized by four criteria: a) Diminished motor activity, b) Reduced responsiveness to stimuli, c) Stereotypical postures (e.g., in humans, lying down with eyes closed), and d) Relatively effortless reversibility. Sleep is classified into Non-REM sleep and REM sleep, which alternate within a sleep cycle.

The three stages of Non-REM sleep (N1, N2, and N3) range from light to deep sleep. In a typical adult, an average sleep duration of approximately 7–8 hours comprise around five cycles where Non-REM and REM sleep alternate [4,5] The best sleep is a healthy interplay between each stage of sleep as well as duration and number of sleep cycles [6].



Physiological Changes During Sleep

Non-REM sleep, which makes up around 75%-80% of the sleep cycle, facilitates physical restoration, memory consolidation (depicted by sleep spindles), emotional equilibrium, and immune system reinforcement. Muscle tone progressively decreases, while heart rate, blood pressure, and respiratory rate decline. Metabolism slows, and the pituitary gland releases growth hormones in a pulsatile manner. Conversely, REM sleep (also known as paradoxical sleep) is associated with memory encoding, dreaming, brain stimulation, and neural development in infants. Rapid eye movement, irregular heart rate, and respiratory fluctuations are characteristic features. Muscle tone is substantially reduced, often accompanied by limb twitching and bruxism [7-12].

Interrelation Between Sleep and Hormones (Concise Overview)

- **Melatonin**: Primarily secreted at night, melatonin induces sleep and is governed by the circadian rhythm. Sleepiness intensifies approximately two hours after melatonin production begins. It acts via suprachiasmatic nucleus (SCN) and suppresses the firing of neurons, also causes phase shift [13,14].
- **Cortisol:** Cortisol secretion follows a circadian rhythm, with levels reaching their lowest point around midnight. Approximately 2-3 hours after sleep onset, cortisol levels begin to rise, continuing through the early morning and peaking around 9 AM. This pattern, known as the "cortisol awakening response", plays a key role in preparing the body for wakefulness. Throughout the day, cortisol levels gradually decline until they reach their nadir again with the onset of sleep. Sleep, particularly slow-wave sleep (SWS), works in conjunction with the circadian system to support an adaptive immune response. During this phase, there is an increase in proinflammatory hormones such as growth hormone and prolactin, while cortisol, an anti-inflammatory stress hormone, remains suppressed. Sleep also plays a crucial role in immunological memory, which can be divided into encoding, consolidation, and recall phases. Both the central nervous system and the immune system rely on sleep to strengthen the consolidation stage of their respective memory processes, enhancing the body's ability to retain and utilize immune responses effectively [15].
 - **Growth Hormone**: Crucial for tissue repair and growth. GH secretion is more during deep sleep as compared to light sleep, predominantly secreted during N3 sleep. It attains its peak after about 70min of sleep onset, and it is the sleep onset which controls GH peak rather than true circadian cycle for GH. This is in contract to cortisol which is governed by its own true rhythm. Though, there is an interrelationship noticed between these two hormones [16]. Sleep related GH release cycle does not follow the typical glucose or somatostatin induced secretion. GHRH may play a more crucial role [17].
 - **Leptin & Ghrelin**: Leptin, a hormone produced by adipocytes, suppresses appetite, while ghrelin, a peptide primarily secreted by the stomach, stimulates hunger. During sleep, leptin levels rise, and ghrelin levels decrease, helping to regulate appetite and prevent night-time binge eating. However, disrupted or insufficient sleep can impair leptin's effects, leading to an increase in ghrelin-driven hunger and a higher risk of overeating and obesity [18].
 - **Insulin:** Physiological blunting of insulin action occurs in normal sleep cycle. It's secretion is enhanced abnormally in sleep deprivation/ alteration leading to hypoglycaemia

and stimulates satiety centre. Obesity and dysregulated glucose metabolism ensues. Various metabolic and mechanistic pathways have been described to relate disturbed sleep and DM [19].

- **Testosterone**: testosterone levels increase during sleep, peaks at the first REM cycle of sleep and continues to remain elevated till the time of waking, being highest around 8am and lowest around 8pm. Uninterrupted sleep, at-the-least for 3hrs of slow-wave-sleep, plays a crucial role. This, uninterrupted sleep can be a part of night sleep or day time sleep. Hence sleep deprivation and fragmented sleep reduces testosterone levels causing fertility issues [20,21].
- **Thyroid-Stimulating Hormone (TSH):** TSH secretion decreases during sleep, promoting metabolic rest. Sleep disruptions trigger excessive TSH release, activating metabolic pathways that induce exhaustion and vice versa. This effect is independent of T4 levels [22].

Public Health Concerns & Sleep Promotion Strategies

Global awareness of inadequate sleep has spurred the demand for accessible sleep enhancement strategies. These include regular physical activity, stress management, minimizing environmental noise, maintaining consistent sleep schedules, and avoiding stimulants like caffeine, nicotine, alcohol, and daytime napping.

Consequences of Disrupted Sleep Cycles [23-25]

- **Short-Term Effects**: Cognitive decline, impaired concentration, diminished attention span, weakened decision-making skills, memory retention deficits, mood disturbances, irritability, anxiety, heightened stress hormone levels, and depleted energy.
- Long-Term Effects: Increased susceptibility to infections (especially viral), compromised immunity, heightened hunger, overeating, carbohydrate cravings, abdominal obesity, cardiovascular diseases (hypertension, myocardial infarction, stroke), type 2 diabetes mellitus, impaired tissue repair, mood disorders, Alzheimer's disease, and reduced life expectancy.

Characteristics of a Healthy Sleep Cycle

A normal sleep latency (time it takes to fall asleep after turning off the lights) ranges between 10 and 20 minutes for adults. Sleep efficiency (the ratio of the amount of time In sleep to the total amount of time spent in bed) of 85% or higher is considered normal. The required sleep duration varies with age:

- Adults: 7–9 hours
- Children (3–5 years): 10–13 hours

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- School-age children (6–12 years): 9–12 hours
- Adolescents (13–18 years): 8–10 hours

The impact of age on quality of sleep, its duration and its overall architecture is strongly proven. Elderly population have difficulty in initiating and maintaining sleep and also tend to spend less time in slow-wave restorative sleep. The reason can be day time napping, overall health and body physiology, changes in circadian, cardiovascular and pulmonary changes and endocrine alterations [26].

Concepts of Power Naps & Sleep Inertia [27-30]

There are two-time slots through the day where there is a dip in performance and attention which is a part of circadian biology. Physiological decrease in core body temperature and increase in melatonin during these time slots can be the probable cause for day time sleepiness. One in mid-morning and the other between 1pm to 4pm. Short duration naps of 10-20min gives quick rest and helps regain the necessary motivation to do further heavy work. This kind of sleep reaches light NREM sleep which help in neural regeneration. Hence it needs to be timed. Post the "power nap" there is increased cortical arousal, focus and alertness, also affects all types of memory positively.

Oversleeping during day time can cause sleep inertia. Sleep inertia is a temporary state of grogginess and reduced alertness that occurs after waking up from sleep. It can affect your mood, performance, and reaction time. Slowed reaction time, poor short term memory, slower thinking, reasoning, remembering and learning time, feeling disoriented and a desire to return to sleep. Hence power naps should be less than 30minutes and taken before 5pm.

- **Coffee Nap:** They are most effective when consumed after lunch, typically in the mid-afternoon. Start by drinking coffee, then take a short nap of no more than 20 minutes for optimal results.
- **NASA Nap**: The original 1995 NASA study revealed that pilots who took a 26-minute nap experienced a 54% boost in alertness and a 34% improvement in job performance [31].

Sleep Hygiene Practices

Prioritizing sleep is essential for maintaining optimal health and cognitive function. Sleep hygiene refers to a set of habits and practices that promote better sleep quality. Following are few established counsels for achieving healthy sleep

• Establishing a consistent sleep routine by going to bed and waking up at the same time every day, including weekends, helps regulate the body's sleep-wake cycle and biological clock. Creating a restful environment with a dark, quiet, and cool sleeping area can further enhance sleep quality. To prevent sleep disruptions, avoid electronic devices with light-emitting screens at least an hour before bed. These impair melatonin release. Exposure to early morning sunlight also helps stabilize the body's internal clock [6,32,33].

- Stimulants such as caffeine, nicotine, and alcohol should be avoided before sleep. Caffeine can take up to six hours to wear off and works by blocking hypothalamic and basal forebrain adenosine receptors. Nicotine present in cigarettes, patches and others, works on overexciting basal forebrain cholinergic neurons. While alcohol may initially induce drowsiness, it can disrupt sleep later in the night causing frequent arousals and light sleep. Higher doses of alcohol has dose-response effect on sleep impairment [34-36].
- Engaging in relaxing activities, such as listening to soft music, reading, or meditating, can help prepare the body and mind for sleep. While short naps can be refreshing, long naps are primarily beneficial for shift workers rather than those following a typical schedule [37].

Role of Physical Activity in Sleep Quality

Moderate to vigorous physical activity can enhance sleep quality in adults by shortening sleep onset—the time it takes to fall asleep-and reducing nighttime wakefulness. It also helps alleviate daytime sleepiness and may lower the need for sleep medications. However, traditional sleep hygiene suggests that intense exercise within three hours of bedtime can negatively impact sleep by raising heart rate, body temperature, and adrenaline levels. Gentle activities like yoga, light stretching, and breathing exercises, on the other hand, can promote relaxation and improve sleep [38,39].

Relaxation Techniques for Sleep

Taking slow, deep breaths is one of the simplest and most effective ways to activate the body's natural relaxation response. Diaphragmatic breathing, also known as belly breathing, is particularly beneficial. Techniques such as 4-7-8 breathing and yoga nidra can further enhance relaxation.

Yoga nidra is an ancient practice that guides individuals through mental imagery while lying on their backs in shavasana, or corpse pose. Unlike traditional sleep, yoga nidra induces deep relaxation while maintaining conscious awareness of the surroundings. Scientific research has shown that this practice can trigger a hypnagogic state, where brain waves slow down, and the body enters a sleep-like state while the mind remains alert. Because of this, researchers suggest that yoga nidra may be a valuable tool for treating insomnia [40,41].

Sleep-Promoting Foods & Beverages [42]

Consuming large meals too close to bedtime can interfere with restful sleep. While nutrition and sleep are closely linked, a balanced diet cannot compensate for poor bedtime habits. To promote better sleep, avoid eating too late in the evening. Research on carbohydrate intake and sleep has shown mixed results, though some evidence suggests that consuming rice may improve sleep quality. Certain foods are particularly beneficial for sleep. These are food which are high in nutritive value and low in calorific value (low energy)

- **Beneficial Foods**: Almonds, walnuts, pistachios, cashews, fish (rich in vitamin D and omega-3s), kiwi, and select red grapes.
- **Foods to Avoid**: Caffeine in the evening, large late-night meals, junk food and excessive alcohol.

Key Considerations for Shift Workers

Shift work includes any work schedule outside the standard hours of 7 AM to 6 PM, encompassing fixed hours, rotating or split shifts, and irregular work times. Unfortunately, there is no substitute for quality sleep, which is especially crucial for employees working night shifts. To maintain a stable sleep-wake cycle, those working from 5 PM to 8 AM should follow the same sleep schedule even on days off [43, 44].

A "split-nap" schedule tends to be more effective, involving a short nap after returning home in the morning and a longer sleep period before the next shift. Rotating shift work generally disrupts sleep more than fixed schedules. However, gradually delaying bedtime by a couple of hours before starting night shifts can help ease the transition. Rotating shifts every two to three days may be preferable to rotations every five to seven days, as sudden changes can be more disruptive. Additionally, too many consecutive night shifts can negatively impact sleep and overall well-being.

Light sleepers may struggle with daytime rest due to exposure to noise and sunlight. Using blackout curtains, an eye mask, or earplugs can help create a more sleep-friendly environment. Establishing a relaxing pre-sleep routine-such as taking a warm shower, meditating, or engaging in another calming activity-can also improve sleep quality.

Final Thought and summary

Sleep is nature's most effective remedy for preserving life and well-being. Prioritizing healthy sleep practices is essential for physical, cognitive, and emotional health.

- Strive for 7 to 9 hours of restful slumber each night
- Maintain a consistent bedtime schedule.
- Engage in regular physical activity

- Steer clear of napping in the late afternoon or evening, and avoid extended naps
- Minimize exposure to light (including screens and electronics) before sleep
- Cut back on caffeine intake later in the day
- Reduce alcohol consumption, especially near bedtime
- Avoid heavy, greasy, or unhealthy meals close to bedtime
- Incorporate mindfulness or relaxation practices
- Ensure your sleep space is dark, cool, and noise-free
- Follow a steady pre-sleep routine
- Reserve your bed strictly for sleep (and intimacy) to reinforce healthy sleep habits
- Opt for a supportive mattress, comfortable pillows, and cozy bedding

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