Rapid Eye Movement (REM) Sleep

Rapid eye movement (REM)[1] sleep is a stage of sleep characterized by rapid movement of the eyes, accompanied by low muscle tone, and vivid dreaming. It is one of the five stages of sleep, along with non-REM stages 1 through 4, that occur in a cyclical pattern throughout the night.

The five stages of sleep are stages 1 through 4 of non-REM sleep[2] and stage 5, which is REM sleep.

- **Non-REM Stage 1:** This is the initial stage of sleep, also known as light sleep. During this stage, the brain activity slows down, and the body begins to relax. It is easy to wake a person up during this stage.
- **Non-REM Stage 2:** In this stage, the brain activity slows down further and the body's temperature and heart rate decrease. The muscles relax even more, and it becomes harder to wake a person up.
- **Non-REM Stage 3:** This is the stage of deep sleep, also known as slow-wave sleep. Brain activity slows down even further, and it is very difficult to wake a person up during this stage. This stage is essential for physical repair and restoration.
- **Non-REM Stage 4:** This stage is similar to stage 3, but it is the deepest stage of sleep, and it is even harder to wake a person up. This stage is also essential for physical repair and restoration.
- **REM Sleep:** Rapid Eye Movement sleep stage, it is characterized by rapid movement of the eyes, accompanied by low muscle tone, and vivid dreaming.

These stages occur in a cyclical pattern throughout the night, with each stage lasting anywhere from 5 to 15 minutes, and the pattern typically repeats every 90-120 minutes.

REM sleep is thought to be important for emotional and cognitive functioning, as well as for the consolidation of memories. The brain activity during REM sleep is similar to that of wakefulness, with increased activity in the prefrontal cortex, which is responsible for decision-making and complex thinking, and decreased activity in the parietal cortex, which is involved in sensory processing.

The first REM stage of the night usually occur around 90 minutes after falling asleep, and the duration of the REM stage increases with each cycle, lasting about 60 minutes in the last cycle before waking. However, the total amount of REM sleep decreases as the night goes on, accounting for around 25% of total sleep time in the first half of the night, and only around 10% in the second half of the night.

During Rapid Eye Movement (REM) sleep, the eyes move rapidly in a variety of directions, hence the name “Rapid Eye Movement”. The exact speed at which the eyes move during REM sleep can vary, but it typically ranges from about 50 to 100 degrees per second. This means that the eyes can move from one side of the visual field to the other in as little as a fraction of a second.

The rapid eye movements during REM sleep are caused by the firing of specific neurons in the brainstem, which control the muscles of the eyes. The brainstem also suppresses the activity of the extraocular muscles that control the movements of the eyes during waking hours, in this way

REM sleep is also essential for a number of physiological functions, it helps to regulate hormones, improve cardiovascular health, and improve energy metabolism, it is also the stage of sleep that help with the formation of new neurons in the hippocampus, an area of the brain that is important for memory and learning.

Disruptions to REM sleep can have negative effects on cognitive and emotional functioning, and may be associated with a number of disorders such as depression, anxiety, and post-traumatic stress disorder.

It is concluded that REM sleep is a unique and vital stage of the sleep cycle, playing a crucial role in cognitive, emotional, and physiological functioning. It is essential to have a healthy sleep hygiene routine to ensure a proper and sufficient amount of REM sleep each night.

REM Deprivation

There have been studies (Ringel BL, Szuba MP, 2001, p.29-36) that have investigated the effects of chronic deprivation of REM sleep in both animals and humans. These studies typically involve either disrupting REM sleep during the night or preventing REM sleep from occurring altogether.

In animal studies, it has been found that chronic deprivation of REM sleep leads to a number of negative effects, including weight loss, decreased immune function, and cognitive impairments. Long-term deprivation of REM sleep also causes an increase in aggressive behavior and a decrease in social interaction.

In human studies, researchers have found that chronic deprivation of REM sleep can lead to a number of negative effects on cognitive and emotional functioning, including difficulties with memory, attention, and decision-making, as well as increased symptoms of depression and anxiety. Studies have also shown that chronic REM sleep deprivation can lead to irritability, lack of concentration, and fatigue.

It's worth noting that these studies were generally short-term, typically for a few days to a few weeks, and in most cases, the subjects were eventually able to recover normal sleep patterns and cognitive functions once the deprivation ended. However, it is still uncertain the long-term consequences of chronic REM deprivation.

REM & Depression

There is a significant relationship between REM sleep and depression. Studies have shown that individuals with depression often have disrupted REM sleep, characterized by increased REM density (more rapid eye movements during the REM stage) and increased time spent in REM sleep. This disrupted REM sleep pattern is thought to be related to the symptoms of depression, such as negative thoughts, emotional disturbances, and difficulty in decision-making.

During REM sleep, the activity in the brain's limbic system, which is responsible for emotions and memories, increases. It is thought that the increased activity in the limbic system during REM sleep may contribute to the vivid and emotionally charged dreams that often occur during this stage. In depressed individuals, the limbic system can become overactive, which could lead to increased negative emotions and disturbing dreams, contributing to depression symptoms.

Also, depression is linked to an imbalance in the neurotransmitters such as Serotonin and norepinephrine, which regulate REM sleep. Low levels of these neurotransmitters have been associated with disturbed REM sleep, which is found in individuals with depression.

Treatment for depression often includes antidepressants, which can affect the regulation of REM sleep. Selective serotonin reuptake inhibitors (SSRIs) are commonly prescribed antidepressants that have been shown to reduce REM sleep. This reduction in REM sleep can lead to an improvement in the symptoms of depression.

There is a complex relationship between REM sleep and depression, with disrupted REM sleep being a potential symptom of depression and treatment with antidepressants also affecting REM sleep. However, more research is needed to fully understand the relationship between the two.

Sleep Deprivation Therapy

Temporary sleep deprivation, which can be achieved through methods such as staying awake all night or disrupting a person's normal sleep schedule, has been shown to have a temporary beneficial effect on the symptoms of depression.

One of the most well-known and researched methods is “sleep deprivation therapy”[3] , which consists in depriving the patient of sleep the night before an antidepressant medication is to be administered, the improvement in depression symptoms can be seen as early as the next day.

The use of sleep deprivation as a therapeutic intervention for depression can be traced back to the early 1900s. The first reports of the antidepressant effects of sleep deprivation were made by psychiatrists in the 1920s and 1930s. However, it wasn't until the 1970s that the phenomenon was systematically studied and the term “sleep deprivation therapy” was coined.

One of the pioneers of sleep deprivation therapy was a researcher from Germany, named A. Rothenberg, who published a study in the 1970s in which he reported that sleep deprivation had an antidepressant effect in patients with unipolar depression.

Another key figure in the development of sleep deprivation therapy is Dr. Thomas Wehr, a researcher at the National Institute of Mental Health (NIMH) in the United States, who conducted extensive research on the effects of sleep deprivation on mood. He published several studies in the 1980s and 1990s, including one of the first studies that systematically evaluated the use of sleep deprivation as a treatment for depression.

It should be noted that these early studies and discoveries on sleep deprivation therapy helped to pave the way for further research in this area, but it still needs further studies to explore the optimal administration and the long-term effects of this treatment as well as its possible side effects, and currently it is only recommended and applied under the guidance of healthcare professionals.

---

[1] Rapid eye movementWikipedia
[2] Non-rapid eye movement sleepWikipedia
[3] Sleep Deprivation TherapyWikipedia
1. ^ Ringel BL, Szuba MP, 2001. Potential mechanisms of the sleep therapies for depression.. *Depression and Anxiety*.