

## The Mechanisms of Sleep and It's Impacts On Your Livelihood

Shamitha Gaddam

### ABSTRACT:

Sleep deprivation has become a frequent issue in society, with a significant portion of the population experiencing the consequences. This review explores the mechanisms, functions, and overall impact of sleep. The paper starts by discussing the various stages of sleep, which include non-rapid eye movement (NREM) and rapid eye movement (REM). The paper also calls attention to the unique characteristics and durations of the stages. One of those characteristics the phenomenon of dreaming is also examined. The paper then further explores the circadian rhythms as well as sleep homeostasis and their roles in regulating the sleep-wake cycle. The review additionally addresses physiological regulations that occur during sleep, including thermoregulation, respiratory changes, and cardiovascular activity. Moreover, the paper states the benefits of adequate sleep include memory enhancement, mood regulation, immune system support, and cardiovascular health. The paper not only elucidates the benefits but also the consequences, which are developing Alzheimer's disease, diabetes, or even obesity. The review paper closes off with common methods that are used to get better sleep; changing your diet and nutrition, sleeping earlier, bright light therapy, medications, and physical exercise. Overall, this comprehensive review provides valuable insights into the importance of sleep and its impact on human livelihood.

### Section 1: Introduction to Sleep

Research has demonstrated the consequences of insufficient sleep, yet in America approximately, 1/3 of adults in the United States are sleeping for less than the recommended amount, which is seven hours per night.<sup>5</sup> Surveys that were conducted by the National Sleep Foundation (NSF) from 1999-2004 showed that at least 40 million Americans suffer from over 70 different sleep disorders and 60% of adults report to have sleep problems for a few nights a week or more.<sup>6</sup> Unfortunately, most individuals that have to deal with these problems go undiagnosed or untreated. More than 40% of adults experience daytime sleepiness, sometimes almost severe enough to interfere with their daily activities for a few days each month, with 20% reporting problems with sleepiness a few days a week or more.<sup>6</sup> Not only adults experience sleep problems. Sixty-nine percent of children also experience one or more sleep problems for a few nights or more during a week.<sup>6</sup> Insufficient sleep is a national concern that impacts the daily functions of both children and adults.

This review will explore how sleep regulates bodily functions, and why receiving the proper amount of sleep plays a vital role in our health. The question that this review will answer is "What are the mechanisms of sleep and how does it impact your livelihood?" The goal of this review is to inform people of the negative consequences they might face if they do not receive adequate sleep, and how their health will benefit with the proper amount of sleep. A literature search was conducted to provide a review of sleep mechanisms and function, the benefits of sleep, as well as the consequences of sleep deprivation.

Sleep is a sedentary state of mind and body that is characterized by altered consciousness, relatively inhibited sensory activity, reduced muscle activity and reduced



interactions with surroundings. For centuries, physicians believed that sleep was a period of brain inactivity, yet research over the last 60 years has shown us that the brain remains active during sleep. Sleep is mostly split into two distinct stages and it cycles through these stages approximately 4-5 times per night.<sup>4</sup> The sleep stages in chronological order are non-rapid eye movement (NREM) and rapid eye movement (REM). The NREM sleep stage is then broken down into stages N1-N3. N1 can last for 1-7 minutes, N2 can last for 10-25 minutes, and N3 can last for 20-40 minutes.<sup>27</sup> Once your body has cycled through the NREM stages, it goes into deep sleep, in other words the next stage, REM sleep, which can last from 10-60 minutes.<sup>27</sup>

The first stage of NREM sleep, which is N1, is the same as when someone falls asleep. During N1 sleep, the body has not completely entered sleep, but the brain activities of the body begin to slowly decrease.<sup>10</sup> There are small changes in brain activity associated with falling asleep in this stage.<sup>10</sup> It is easy to wake someone up during N1, but when a person is not disturbed, they will quickly move to the N2 stage.<sup>10</sup> During the N2 stage, the body enters a slightly more dejected state indicated by a drop in temperature, relaxed muscles, and slowed breathing and heart rate.<sup>10</sup> At the same time, brain waves show a different pattern and eye movements stops.<sup>10</sup> A person spends almost half of their sleep period in the N2 sleep stage. The next stage is N3 sleep, or the deepest sleep stage of NREM. During this stage it is more difficult to wake someone. Muscle movement, pulse, and breathing rate decrease in N3 sleep as the body further relaxes.<sup>10</sup> The brain activity during this period has patterns that are referred to as delta waves. Due to these delta waves, N3 sleep is also called delta sleep or slow-wave sleep (SWS).<sup>10</sup> Experts state that this stage is significant to restorative sleep, allowing for body to recover and grow. It may also bolster the immune system.<sup>10</sup> Lastly, the second main stage is REM sleep. During REM sleep, brain activity picks up to the levels that are seen when you are awake. Despite the fact that the eyes are closed during this stage, they are moving quickly, which is how this stage got its name. At the same time, the body undergoes atonia, which is a temporary paralysis of the muscles, with the exception of the eyes and the muscles that control breathing.<sup>10</sup> REM sleep is important to cognitive functions like memory.

As an individual begins to fall asleep, there is a progressive decrease in the firing rate of neurons throughout the brain as sleep moves from wakefulness to the first stage of sleep—NREM sleep.<sup>2</sup> Moreover, the patterns of neuronal firing change from a seemingly random and variable activity pattern during wakefulness, to a more coordinated and synchronous pattern during NREM sleep.<sup>2</sup> In the progression from stage N1 to N3, brain waves become slower and more synchronized, and the eyes remain still.<sup>2</sup> In stage N3, the deepest stage of NREM, electroencephalogram (EEG)—which measures brain electrical activity through electrodes attached to the scalp—reveals high-amplitude, low-frequency waves and spindles.<sup>2</sup> Spindles on the EEG readout indicate a person has fallen asleep.<sup>8</sup> During the next sleep stage, REM sleep, the firing rate of neurons throughout the brain will increase. In fact, the brain in REM sleep can be even more active than when we are awake. Patterns of REM sleep brain activity tend to be more random and variable, making this stage similar to wakefulness. This pattern of brain activity during REM sleep is believed to be located in the pontine reticular formation, a brain region in the center of the pons, which is part of the brainstem. This pontine reticular formation takes part in the coordination of eye movements, particularly horizontal gaze.

During the final stage of the sleep cycle, which is REM sleep, one of the most striking but least understood characteristics of sleep happens. During dreaming our thoughts follow unique and sometimes illogical sequences. These sequences are usually random and sometimes related to experiences that were gathered during wakefulness. Visually intense dreaming occurs primarily during REM sleep. However, not all dreams do take place during REM sleep. For example, night terrors occur during NREM sleep.<sup>2</sup> Multiple explanations for dreaming, as well as definitions of dreams, have been offered by philosophers and psychologists throughout history. In a recent investigation on neurobiological mechanisms of dreaming, researchers confirmed that the posterior parietal area and prefrontal cortex are responsible for our dream experience.<sup>9</sup> However our dreams still remain a mystery. Some experts suggest that dreams represent the replay of the day's events as a critical mechanism in the formation of memories, while others claim that the content of dreams is simply the result of random activity in the brain.<sup>2</sup>

Two interacting biological systems: the circadian rhythms and sleep homeostasis determine the timing of our transitions from when we are awake to when we are asleep. These two factors also explain why, under normal conditions, we typically stay awake during the day and sleep at night.<sup>2</sup> Circadian rhythms direct a wide variety of functions from daily fluctuations in wakefulness to body temperature, metabolism, and the release of hormones.<sup>4</sup> They control your timing of sleep and cause you to be sleepy at night and your ability to wake in the morning without an alarm.<sup>4</sup> Your body's biological clock, which is based on a roughly 24-hour day, controls most circadian rhythms.<sup>4</sup> Circadian rhythms are in sync with environmental cues such as light and temperature information rather than the time of the day, but circadian rhythms tend to still exist without environmental cues as well. Sleep homeostasis is a regulated balance between sleep and waking. As your time awake increases, your sleep pressure, or homeostatic drive to fall asleep, builds up in your body.<sup>4</sup> The combined modulation of sleep homeostasis and circadian rhythms together set your 24-hour sleep-wake cycle.

Sleep patterns do not remain consistent throughout life, and are affected by many factors, those being age, the amount of recent sleep, the time of the day or night relative to an individual's internal biological clock, exercise, stress, environmental conditions such as and various chemicals. For example, sleep often begins in the REM stage instead of NREM for the first year of life as it occurs in adults. The change of the two stages in the cycle of NREM to REM sleep in newborns occurs at 50-60 minute intervals, which is much shorter than the 90-minute cycles that occur in adults. Sleep and fully developed EEG patterns of the NREM sleep stages emerge only after two to six months.<sup>23</sup> Slow-wave sleep is most prevalent in young children and it decreases steadily with age, even if sleep duration does not change.<sup>2</sup> This may be related to changes in the structure and function of the brain. Sleep history—the quantity and quality of an individual's sleep—can also have dramatic effects on sleep patterns.<sup>2</sup> Repeatedly missing a night's sleep, an irregular sleep schedule, or frequent disturbances to sleep results in a mix up of sleep stages. For instance, you might have prolonged and deeper periods of slow-wave NREM sleep. Drugs also affect sleep stages. A common example would be alcohol. Alcohol before sleep tends to subdue REM sleep early in the night. As the alcohol is metabolized, REM sleep rebounds later in the night. However, awakenings also become more frequent during this time.<sup>2</sup>

Sleep regulates many biological factors, including body temperature, respiratory changes, and cardiovascular activity. Body temperature is regulated through a process known as thermoregulation.<sup>29</sup> In this process the temperature of our body is controlled by mechanisms including shivering, sweating, and changing blood flow to the skin.<sup>29</sup> During this time temperature fluctuation is minimal and stays at a set level during wakefulness.<sup>29</sup> Researchers believe that losing heat from our body into the environment just before falling asleep, helps to induce sleep.<sup>29</sup>

During sleep, our central set temperature is reduced by 1-2°F. Due to this we use less energy as an attempt to maintain our body temperature.<sup>30</sup> It has been concluded that one of the primary functions of sleep is to conserve energy in this way.

Sleep also controls our respiratory changes. When we are awake, breathing is irregular as it is affected by speech, emotions, exercise, and posture. As we advance from wakefulness into the stage of non-REM sleep, our breathing rate decreases by a little and becomes more regular, while during REM sleep, the pattern becomes variable and breathing rate increases again.<sup>31</sup>

Sleep also regulates cardiovascular activity by giving the heart a chance to take a break from the constant demands of daily life. Compared to wakefulness, during NREM sleep there is a complete reduction in heart rate and blood pressure. During REM sleep, however, there is a more significant variation in cardiovascular activity, with increases in blood pressure and heart rate. Additionally, changes in blood flow that cause erections in males or swelling of the clitoris in females is characteristic of REM sleep.<sup>24</sup> The underlying reason for these considerable neural and physiological variations in REM sleep is currently unknown, and may be a result of REM-related changes in nervous system activity or related to dream content.<sup>24</sup>

In general, many physiological activities are reduced during sleep. For example, kidney function slows and the production of urine is decreased, but some physiological processes may be controlled or even increased during sleep. One of the greatest changes from sleep is an increase in the release of growth hormone. Specific physiological activities that are connected to digestion, cell repair, and growth are often greatest during sleep.

## Section 2: The Benefits of Sleep

A consensus created by the American Academy of Sleep Medicine and Sleep Research Society states that “Adults should sleep 7 or more hours per night on a regular basis to promote health”.<sup>3</sup> When you receive the average recommended amount of sleep one needs, you tend to stay healthier and get sick less often. Sleep plays a vital role in a person's well being, mentally, and physically. The actions you take, and the mood you endure while you are awake largely depends on what happens while you are sleeping, and the amount of sleep you receive.



**Figure legend:** Although there can be many more, five main benefits to sleep: ensures healthy brain function, strengthens memory, enhances mood, boosts your immune system, and keeps your heart in good shape.

While sleeping, your body is supporting your brain so it can function healthily, along with maintaining your physical health through various mechanisms. Examples would be releasing hormones that help repair cells, removing toxic waste byproducts in the brain, as well as contributing to weight control.<sup>3</sup> Sleep is a complex and dynamic process that affects how you function in ways scientists are only now beginning to understand.<sup>4</sup> Quality sleep, and getting enough of it at the right times is as essential to survival as food and water.<sup>4</sup> Sleep can be a benefit to one through many ways, like enhancing your memory, mood, immune system, and heart.

One of the biggest aids from getting a good amount of sleep is an increase in memory. It is claimed that memories will become more stable in the brain during the deep stages of sleep.



After that, REM—the most active stage of sleep—plays a role in linking together related memories. That’s why a full night of sleep may help with problem-solving.<sup>11</sup> Learning and memory are expressed in three main functions. One of them is acquisition, which refers to the introduction of new information into the brain. The second one is consolidation, which represents the processes by which a memory becomes stable. Lastly, there is recall, which refers to the ability to access the information (whether consciously or unconsciously) after it has been stored. All of these steps are necessary for proper memory function. Although acquisition and recall only come about during wakefulness, research does suggest that memory consolidation also takes place during sleep through the strengthening of the neural connections that form our memories. Although there is no consensus about how sleep makes this process possible, many researchers think that specific characteristics of brain waves during different stages of sleep are associated with the formation of particular types of memory.<sup>16</sup> In a research study, individuals who were engaged in an intensive language course were observed to have an increase in rapid-eye-movement sleep, or REM sleep. As we know, this is a stage of sleep in which dreaming occurs most frequently. From this study scientists hypothesized that REM sleep played a crucial role in the acquisition of learned material. Further studies have suggested that REM sleep looks to be involved in declarative memory processes, usually if the information is complex and emotionally charged.

Sleep not only enhances your memory but it also helps your mood. Sleep studies are linking effects of sleep to mood, showing that partial sleep deprivation has a significant effect on distinguished happiness. University of Pennsylvania researchers found that subjects who were limited to only 4.5 hours of sleep a night for one week reported feeling more stressed, angry, sad, and mentally exhausted.<sup>12</sup> When these subjects were asked to resume normal sleep, they reported a dramatic improvement in mood.<sup>12</sup>

Sleep also boosts your immune system. When we sleep, our bodies produce a protein called cytokines. This protein targets infection and inflammation, creating an immune response. Our bodies also produce T-cells during sleep, which are white blood cells that play a critical role in our body’s immune response to an infectious disease.<sup>13</sup> Ideally, our bodies require seven to nine hours of quality sleep to recharge and to keep our immune system strong.<sup>13</sup>

Sleep even keeps your heart strong. During non-REM sleep, your heart rate, breathing and blood pressure all drop to levels below those that occur while you are awake.<sup>12</sup> During normal sleep, your blood pressure goes down which prevents high blood pressure, keeping your body and heart healthy. Apart from getting the right amount of sleep, one's sleep must also be consistent in order to see long lasting results on the heart. In other words, consistent sleep is vital to heart health.

A study executed by National Heart, Lung, and Blood Institute (NHLBI), and the National Center for Research Resources (NCRR) confirmed that multiple biological factors affect our sleep, and that without the right amount of sleep you are at risk of developing memory problems, heart disease, obesity, and diabetes. This inpatient study examined two extreme sleep groups: short sleepers who sleep 6.5 hours or less a night and long sleepers who sleep 9 or more hours a night.<sup>25</sup> Participants were exposed to identical sleep opportunities and living

conditions. Using hormone analysis to examine participants' circadian rhythms, researchers evaluated the biological differences that people undergo during the sleep process.<sup>25</sup> Results from this study demonstrated that the sleep duration and sleep needs differ amongst people. Based on the environment they are placed in when they are sleeping, not only do biological factors affect our sleep, but environmental factors affect our sleep just as much.<sup>25</sup>

Although many daily life factors can affect the amount of sleep one gets, we must try our best to set aside some time for our well being and health, otherwise we tend to face consequences.

### Section 3: The Consequences of Insufficient Sleep

In America, 70% of adults report that they obtain insufficient sleep at least one night a month, and 11% report insufficient sleep every night.<sup>7</sup> This is a significant problem as insufficient sleep can harm our body in a variety of ways. Not getting the right amount of sleep can cause many chronic health problems including cardiovascular disease, kidney disease, high blood pressure, diabetes, stroke, obesity, Alzheimer's disease, and depression. Sleep deficiency is also linked to a higher chance of injury in adults, teens, and children. The pain and fatigue of these chronic illnesses have a large impact on people's daily activities in their lives. Due to these illnesses, people who have them often face trouble sleeping at night and instead, are sleepy during the day. A sleep-deprived person cannot focus attention optimally and therefore cannot learn efficiently.<sup>26</sup>

## 3 Consequences of Sleep Deprivation



**Figure legend:** Of the various consequences of sleep deprivation, the ones that are reviewed in this paper include developing Alzheimer's, diabetes, or obesity caused by a lack of sleep

Increased risk of developing Alzheimer's disease is one of the most significant consequences of sleep deficiency. Some recent studies suggest that poor sleep contributes to

abnormal levels of beta-amyloid protein in the brain, which in turn leads to the amyloid plaques found in the diseased brain of an individual with Alzheimer's.<sup>14</sup> These plaques might then affect sleep-related brain regions, further disrupting sleep.<sup>14</sup> Studies done on humans have also addressed the relationship between sleep and biomarkers of Alzheimer's disease. One study found that in cognitively normal older adults, poor sleep quality (more time awake at night and more daytime naps) was associated with lower beta-amyloid levels in cerebrospinal fluid, a preclinical sign of Alzheimer's.<sup>28</sup> Another study, by researchers at NIA and Johns Hopkins University (Baltimore, MD), found that healthy older adults who reported short sleep duration and poor sleep quality had more beta-amyloid in the brain than those without such sleep problems.<sup>28</sup>

Diabetes risk can be increased by sleep deprivation. Lack of sleep will cause a reduced amount of insulin to be released in your body once you eat. Too much glucose tends to stay in the bloodstream, which increases your risk of developing type 2 diabetes. When insulin is not functioning properly, high blood sugar levels build in the body reaching a point where they can harm the eyes, kidneys, nerves, or heart. The restorative stage of sleep or "deep sleep" plays a big part in maintaining proper insulin levels and blood sugar control.<sup>15</sup> If loss of sleep only occurs for a few days, these potentially damaging effects can be reversed. However, it is recommended that you get seven to nine hours of uninterrupted sleep every night to reduce your risk of type 2 diabetes and maximize your body's full functioning.<sup>15</sup>

Along with Alzheimer's and diabetes, not getting enough sleep can also increase risk of obesity. A hormone imbalance takes place when there is a lack of sleep, resulting in weight gain. When you aren't getting sufficient sleep, leptin and ghrelin, the hormones that regulate appetite, and the production of these hormones, are altered in a way that produces increased feelings of hunger. Increased hunger tends to lead to increasing calories and weight gain.<sup>20</sup>

Overall sleep does not only cause chronic health problems, but it also makes it harder for your brain to function. An insufficient amount of sleep makes it tougher to make healthy choices. Sleep deprivation decreases activity in the frontal lobe of the brain. The frontal lobe has the ability to let the body have decision making skills as well as self-control. Poor sleep can decrease the abilities of the frontal lobe, in return making daily activities to be problematic. Sleep deficiency can interfere with work, school, driving, and social functioning.<sup>21</sup> This means you will have difficulty learning, focusing, and reacting. Also, you might find it hard to judge other people's emotions and reactions.<sup>21</sup> Sleep deficiency can also make you feel angry, cranky, frustrated, or worried in social situations, which are situations most of us have to face in our lives. Therefore it is best to try and get a good night of sleep whenever you can!

#### **Section 4: Methods to help improve sleep**

Numerous factors can prevent you from getting a restful night of sleep. These factors can vary from work stress and family responsibilities to illnesses. Quality sleep can sometimes be quite difficult to track down. Although some factors might be uncontrollable, there are ways you can adopt habits that will help ensure a better sleep. For example, maintaining a healthy diet, going to sleep earlier, using bright light therapy, limiting coffee consumption, including taking medications if needed and adding physical activity in your daily routine can improve your sleep.





**Figure legend:** There are various ways to help improve your sleep or make it easier to fall asleep, among those include a healthy diet, going to bed earlier, taking medications, receiving bright light therapy, and making sure to include physical exercise in your daily routine

Diet and nutrition can influence the quality of your sleep, and certain foods and drinks can make it easier or harder to get the sleep that you need.<sup>16</sup> At the same time, getting enough sleep is associated with maintaining a healthier body weight and can be beneficial for people who are trying to lose weight.<sup>16</sup> Maintaining a healthy diet can improve your sleep in many different ways. As a general rule, a balanced diet made up largely of a variety of vegetables and fruits is able to provide the recommended daily intake of vitamins and nutrients, contributing to better sleep while promoting a healthy weight.<sup>16</sup> Various kinds of diets can offer this type of nutritional balance, and most have been evaluated more closely for the effect they have on sleep. One of those diets is the Mediterranean Diet. This diet is plant-based and incorporates lean meats and high-fiber foods to improve heart health and sleep quality. The Dietary Approaches to Stop Hypertension diet, or DASH diet, involves reduced salt and saturated fats along with a focus on

whole foods with high levels of fiber, potassium, and magnesium.<sup>16</sup> The DASH diet was designed to reduce blood pressure, but research has found that people who closely follow it tend to report better sleep.<sup>16</sup>

Sleeping earlier will benefit your sleep quality quite significantly. Moving your bedtime up by simply just 60 minutes could possibly have great benefits for your mental and physical health. Being happier, and limiting your stress could be as simple as getting an extra hour of sleep every night, and then rising and shining with the sun the next morning; doing so aligns your biological clock with its natural rhythm.<sup>17</sup> Getting more sleep will put you in a better mood, so you can spend quality time with friends or family.<sup>17</sup> When you are weary, your concentration, memory capacity, and logical reasoning decline restricting one from performing your best at work. In fact, one study found that subjects performed 30% better on a puzzle after waking up from a deep sleep than from light snoozing.<sup>17</sup> Research has concluded that sleep is necessary to help people solve many different complex problems, too. Simply put, setting back your bedtime by just one hour could give you a competitive advantage and make you more successful at your job.<sup>17</sup>

There are also other options to improve your sleep, such as bright light therapy. Bright light therapy is designed to treat specific health conditions through exposure to artificial light. During a light therapy session, the person sits in front of a specialized device, known as a light therapy box, that emits bright light similar to natural sunlight.<sup>18</sup> This is done for a set amount of time each day. To avoid damage, the light should not shine into your eyes directly. The light boxes intended for light therapy emit strong light that mimics outdoor light, but without the harmful UV rays.<sup>18</sup> Typically, patients use a light box with a light intensity measuring 10,000 lux, positioned between 16 to 24 inches away from the face.<sup>18</sup> When used consistently and as recommended by a doctor, exposure to this light helps reset your circadian rhythm — the technical term for your body clock.<sup>18</sup> As a result, individuals who experience light therapy are able to fall asleep earlier and faster at night, or they could even sleep in later in the morning. The effects will vary from person to person.

Medications are also available for improvement of sleep. Sleeping pills are commonly prescribed by doctors. There are several different types of sleeping pills, classified as sedative hypnotics. These medications mostly take action by working on receptors in the brain to slow down the nervous system. Some medications are used frequently to induce sleep, while others are used to make a patient stay asleep. Although, some medications stay in your system longer than others, and some medications will have a higher risk of a habit forming. Benzodiazepines are the oldest class of sleep medications still commonly in use.<sup>19</sup> Benzodiazepines as a group are thought to have a higher risk of dependence than other insomnia sedative hypnotics and are classified as controlled substances.<sup>19</sup> Primarily used to treat anxiety disorders, benzodiazepines have also been approved to treat insomnia.<sup>19</sup> Ramelteon is the newest type of sleep medication and works by mimicking the sleep regulation hormone melatonin.<sup>19</sup> This medicine was created in 2005. Ramelteon has a slight risk of physical dependency and will still have side effects. These side effects include body aches, change in taste, difficulty breathing, difficulty moving, and fatigue.<sup>22</sup> It is used for sleep onset problems and is not effective for problems regarding staying asleep.<sup>19</sup>

Another way to improve your sleep is including physical exercise in your daily routine. For example, moderate aerobic exercise, which is the practice of brisk walking, swimming, or mowing the lawn, will increase the amount of slow wave sleep you get. Slow wave sleep refers to deep sleep, where the brain and body have a chance to rejuvenate.<sup>20</sup> Exercise also benefits you by stabilizing your mood and decompressing the mind, making it easy for the cognitive process of transition to sleep to occur. Aerobic exercise causes the body to release endorphins.<sup>20</sup> These chemicals can create a level of activity in the brain that keeps some people awake.<sup>20</sup> As such, these individuals should exercise at least 1 to 2 hours before going to bed, giving endorphin levels time to wash out and the brain time to wind down.<sup>20</sup> Exercise also raises your core body temperature.<sup>20</sup> The body clock will be signaled that it is time to be awake, when the core body temperature becomes higher. About 30 to 90 minutes after the temperature elevation, the core body temperature will start to fall or decrease. This temperature decline will make it a lot easier to facilitate sleepiness. Despite these biological responses to exercise, some people find that the time of day they exercise doesn't make a difference.<sup>20</sup>

## Section 5: Conclusion

Sleep is known as a changed state of consciousness where we have less interactions with our surroundings and are unusually quiet and still (depending on the stage of sleep). As we would not expect, the brain is in fact very active during sleep, carrying out many important functions. Sleep is essential to almost every process in the body, affecting our physical and mental functioning from day to day, our ability to develop immunity, and our metabolism. Getting the right amount of sleep comes with many benefits, including memory and mood enhancement, along with a healthy heart. On the other hand, not getting enough sleep comes with its own consequences, such as kidney disease, depression, and diabetes. However, there are multiple options or methods we can take to ensure that we get a good sleep. These options vary from a healthy diet to simply just fitting physical exercise into our daily routines. Sleep is vital to health and truly interdisciplinary because it touches every aspect of health.

The goal of this article was to convey what sleep is and how it can affect humans in a positive and negative way. To accomplish this goal, I have conducted a literature review and overviewed sleep, sleep cycles, benefits of sleep, and consequences of sleep. I have also discussed methods to improve sleep, which consist of maintaining a healthy diet, going to sleep earlier, using bright light therapy, limiting coffee consumption, including taking medications if needed and adding physical activity in your daily routine. With these small changes, one can reap the positive benefits of receiving proper sleep, avoid the negative consequences that result from sleep deprivation, and overall lead a happier and healthier lifestyle.

## References

- [1] Why Is Sleep Important? (2022, March 24). *National Heart, Lung, and Blood Institute*. <https://www.nhlbi.nih.gov/health/sleep/why-sleep-important#:~:text=During%20sleep%2C%20your%20body%20is,long%2Dterm>.
- [2] *The Characteristics of Sleep, Healthy Sleep*. (2007 December 18). <https://healthysleep.med.harvard.edu/healthy/science/what/characteristics>
- [3] Watson, N. F., Badr, M. S., Belenky, G., *et al.* (2015). Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep*, 38(6): 843-844, <https://doi.org/10.5665/sleep.4716>
- [4] *Brain Basics: Understanding Sleep*. (2023 March 27). *National Institute of Neurological Disorders and Stroke*. <https://www.ninds.nih.gov/health-information/public-education/brain-basics/brain-basics-understanding-sleep>
- [5] 1 in 3 adults don't get enough sleep. (2016, February 18). *CDC Newsroom*. <https://www.cdc.gov/media/releases/2016/p0215-enough-sleep.html>
- [6] Why sleep is important. (2020, May 14). *American Psychological Association*. <https://www.apa.org/topics/sleep/why>
- [7] The State Of Sleep Health In America In 2023 (2023). *SleepHealth - The American Sleep Health Organization*. <https://www.sleephealth.org/sleep-health/the-state-of-sleephealth-in-america/#:~:text=In%20America%2C%2070%25%20of%20adults,report%20insufficient%20sleep%20every%20night.&text=It%20is%20estimated%20that%20sleep,all%20ages%20and%20socioeconomic%20classes>
- [8] Summer, J. & Rehman, A. (2022). Sleep Spindles. *Sleep Foundation*. <https://www.sleepfoundation.org/how-sleep-works/sleep-spindles#:~:text=When%20sleep%20spindles%20appear%20on,not%20occur%20during%20REM%20sleep>.
- [9] Scarpelli, S., Alfonsi, V., Gorgoni, M., Giannini, A. M., & De Gennaro, L. (2021). Investigation on Neurobiological Mechanisms of Dreaming in the New Decade. *Brain Sciences*, 11(2): 220. <https://doi.org/10.3390/brainsci11020220>
- [10] Suni, E. & Vyas, N. (2023). Stages of Sleep. *Sleep Foundation*. <https://www.sleepfoundation.org/stages-of-sleep>
- [11] Sleep On It. (2017, July 13). *NIH News in Health*. <https://newsinhealth.nih.gov/2013/04/sleep-it#:~:text=Memories%20seem%20to%20become%20more,may%20help%20with%20problem%2Dsolving>.

- [12] Colten, H. R. & Altevogt, B.M. (2006). Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem. *National Academies Press*.  
<https://www.ncbi.nlm.nih.gov/books/NBK19961/>
- [13] Better Sleep Habits to Strengthen Immunity. (n.d.). *UC Health*.  
<https://www.uchealth.com/en/media-room/covid-19/better-sleep-habits-to-strengthen-immunity#:~:text=When%20we%20sleep%2C%20our%20bodies,disease%20such%20as%20COVID%2D19.>
- [14] Sleep deprivation: A cause of high blood pressure? (2022, August 9). *Mayo Clinic*.  
<https://www.mayoclinic.org/diseases-conditions/high-ood-pressure/expert-answers/sleep-deprivation/faq-20057959#:~:text=It's%20thought%20that%20sleep%20helps,risk%20factors%20for%20heart%20disease.>
- [15] Connection between lack of sleep and Type 2 diabetes. (n.d.). *Reid Health*.  
<https://www.reidhealth.org/blog/the-connection-between-lack-of-sleep-and-type-2-diabetes#:~:text=Lack%20of%20sleep%20causes%20less,of%20developing%20type%202%20diabetes>
- [16] Suni, E. Troung, K. (May 18, 2023). Nutrition and Sleep. *Sleep Foundation*.  
<https://www.sleepfoundation.org/nutrition>
- [17] Nelson, B. (2022, March 17). 11 Wonderful Things that Could Happen If You Go to Bed an Hour Earlier. *The Healthy*. <https://www.thehealthy.com/sleep/benefits-going-to-bed-earlier/>
- [18] Smith, M. Lawrence,R. (2023). Sleeping Pills and Natural Sleep Aids. *HelpGuide.org*.  
<https://www.helpguide.org/articles/sleep/sleeping-pills-and-natural-sleep-aids.htm#:~:text=The%20are%20several%20different%20types,are%20used%20for%20staying%20asleep.>
- [19] Exercising for Better Sleep. (2021, August 8). *Johns Hopkins Medicine*.  
<https://www.hopkinsmedicine.org/health/wellness-and-prevention/exercising-for-better-sleep#:~:text=Exercise%20also%20raises%20your%20core%20body%20temperature.&text=Elevation%20in%20core%20body%20temperature,decline%20helps%20to%20facilitate%20sleepines>
- [20] Attardo, D. (January 18, 2022) Sleep, Obesity and How They Are Related *Lifespan*,  
<https://www.lifespan.org/lifespan-living/sleep-obesity-and-how-they-are-related#:~:text=Effects%20of%20lack%20of%20sleep%3A&text=Leptin%20and%20ghrelin%20are%20hormones,in%20creasing%20calories%20and%20weight%20gain.>
- [21] What Are Sleep Deprivation and Deficiency? (2022, March 24). *National Heart, Lung, and Blood Institute*. <https://www.nhlbi.nih.gov/health/sleep-deprivation>



- [22] Ramelteon (Oral Route) Side Effects (n.d.). *Mayo Clinic*.  
<https://www.mayoclinic.org/drugs-supplements/ramelteon-oral-route/side-effects/drg-20067544?p=1>
- [23] Suni, E. (2021, December 2). Stages of sleep: What happens in a sleep cycle (N. Vyas, Ed.). *Sleep Foundation*. <https://www.sleepfoundation.org/stages-of-sleep>
- [24] Snoring Cure Kannur/Thalassery | *Sleep Disorder Treatments Kannur*. (n.d.). Retrieved June 13, 2023, from <https://www.thehealthysleep.in/physiological-changes-during-sleep/>
- [25] Aeschbach, D., Brigham and Women's Hospital, National Heart, Lung, and Blood Institute (NHLBI), & National Center for Research Resources (NCRR). (2013, July 30). *Neurobiology of Individual Differences in Sleep Duration*. Clinicaltrials.gov.  
<https://clinicaltrials.gov/ct2/show/NCT00607204>
- [26] Sleep, Learning, and Memory The Characteristics of Sleep At a Glance. (n.d.).  
[http://www.elegantbrain.com/edu4/classes/readings/depository/TNS\\_560/sleep\\_procras/sleep.pdf](http://www.elegantbrain.com/edu4/classes/readings/depository/TNS_560/sleep_procras/sleep.pdf)
- [27] John Hopkins Medicine. (2019). The Science of Sleep: Understanding What Happens When You Sleep. *Johns Hopkins Medicine Health Library*.  
<https://www.hopkinsmedicine.org/health/wellness-and-prevention/the-science-of-sleep-understanding-what-happens-when-you-sleep>
- [28] Spira, A. P., Chen-Edinboro, L. P., Wu, M. N., & Yaffe, K. (2014). Impact of sleep on the risk of cognitive decline and dementia. *Current Opinion in Psychiatry*, 27(6), 478–483.  
<https://pubmed.ncbi.nlm.nih.gov/25188896/>
- [29] Osilla, E. V., & Sharma, S. (2022, May 8). Physiology, Temperature Regulation. *Nih.gov; StatPearls Publishing*. <https://www.ncbi.nlm.nih.gov/books/NBK507838/>
- [30] Harding, E. C., Franks, N. P., & Wisden, W. (2019). The Temperature Dependence of Sleep. *Frontiers in Neuroscience*, 13. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6491889/>
- [31] Xie, A. (2012). Effect of sleep on breathing - Why recurrent apneas are only seen during sleep. *Journal of Thoracic Disease*, 4(2), 194–197.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3378217/>

