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Sleep, its Attributes, Deprivation & Hygiene: A Recapitulation

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ABSTRACT

Sleep is a biological and behavioral phenomenon that has been studied from many different perspectives. Today it is clear that sleep quantity and quality is related to the development of chronic diseases and even mental disorders. However, many people ignore their sleep habits and fail to take active steps to adopt sleep hygiene practices preferring instead to relay on non-prescribed or prescribed pharmacological products. As a result of the potential consequences of sleep deprivation, health care professionals should be vigilant of how managing underlying medical conditions may help to optimize sleep continuity and consider prescribing interventions that minimize sleep disruption.

Keywords: Sleep; Sleep deprivation; Sleep hygiene

INTRODUCTION

Almost every night we are engaging ourselves in a sound sleep. However, pattern of sleep and its features vary from person to person. Various body functions such as metabolism, appetite, cardiovascular system, and immune system has been maintained and regulated by sleep. Hence, for the optimum level of health, sleep is an important factor. [1,2] Sleep is a state of reduced consciousness that is relatively easy to reverse. A normal healthy sleep is distinguish by good quality, appropriate time and regularity, enough duration and without any sleep disorder and disturbance.[3]

Attributes of normal sleep

The stages of sleep have historically been divided into one stage of rapid eye movement (REM) sleep and four stages (Stages 1–4) of non-rapid eye movement (NREM) sleep that are characterized by increasing sleep depth. As the night progresses, this REM sleep increases and is longest in the last one-third of a sleep episode. The most restorative type of sleep is called as deeper sleep stage and it is also known as slow- wave sleep (SWS). This stage is generally takes place during the first one-third of night. [4,5] Features of REM and NREM are differentiated by numerous physiological changes such as brain functioning, blood pressure , heart rate, endocrine system, body temperature, sexual arousal and sympathetic nervous system. For example, when we are in NREM stage, then our blood pressure, heart rate, respiration, flowing of blood in the brain; all are decreased as compare with wakeful periods. While on the other hand, when we are in REM stage, all of the above mention functions increased as compare with NREM sleep. Brain activity decreased in NREM sleep but its activity level is similar during REM sleep except in the area of motor as well as sensory, where brain activity level increased.[4]

American Academy of Sleep Medicine has given a new classification of sleep and as per this classification, only three stages of NREM sleep developed and these are: lighter sleep and deeper sleep. Stage N1 and N2 are the lighter sleep and stage N3 is a deeper sleep.[6] This new classification given by American Academy of Sleep Medicine has been focused on electroencephalogram (EEG) derivations and the incorporating of Stages 3 and 4 into

Stage N. While comparing both of these sleep classification, only a slight differences were found out which is related to sleep efficiency, REM sleep and sleep time. The distribution of NREM sleep stages and measurement of wakefulness after sleep onset, affect the choice of sleep classification. [7]

The exchange between the sleep-promoting process (process S) and the maintenance of wakefulness system (process C), has been explained by the two-process model. The regulation of the sleep–wake cycle has been attained by the balance between process C and process all the time. This sleep-wake cycle is also regulated by circadian rhythms. Circadian rhythm is a 24 hours daily rhythm of physiology and behavioral changes that occurs in the body. Throughout the physical activity, food consumption, hormone secretion, body temperature, heart rate and muscle tone, circadian rhythms control the metabolic activity of the body.[4]

In order to allow sleep to occur, neurons in the hypothalamus turn off the arousal systems and hence, regulate the sleep process. As these neurons regulate the sleep process, loss of these neurons leads to sleep disturbance, insomnia and other sleep related disorders. Not only the neurons, but other brain regions like brain stem and cognitive areas of the forebrain are also responsible for disturbance in sleep. By sending the outputs to the brain stem and spinal cord, neurons in the pons switch between NREM and REM sleep throughout the night and causes the chaotic autonomic activity and muscle atonia; to the forebrain; and to the thalamus via cholinergic pathways. [8]

Via the suprachiasmatic nucleus (SCN), these circadian rhythms work to synchronize sleep with the external day–night cycle. This suprachiasmatic nucleus (SCN) act as brightness detectors by receiving the direct input from nerve cells in the retina. From the retina to the suprachiasmatic nucleus, light travel and give signals to pineal gland for controlling the secretion of melatonin. To synchronize the circadian rhythms with the environment and the body, a neurohormone: melatonin is essential. In nearly all tissues, this synchronization is possible only because of melatonin receptors. To maintain the daily patterns of activity suprachiasmatic nucleus works with a series of clock genes to synchronize the peripheral tissues. [8]

Sleep deprivation and its physiologic effects: Sleep disorders has been classified into various category like obstructive sleep apnea[9,10], narcolepsy, sleep walking, insomnia and restless legs syndrome(related to altered dopamine and iron metabolism; >50% of idiopathic cases of restless leg syndrome have a positive family history.[11,12]). Sleep deprivation is also categorized under sleep disorder. Sleep deprivation has been associated with numerous major medical conditions particularly those that require nighttime medical monitoring (eg, continuous glucose monitoring for individuals with diabetes) [13] or hospitalization, especially in an intensive or critical care unit. [14,15] A primary mechanisms has been identified by various sleep deprivation studies and this mechanism showed various adverse short- and long-term health effects of sleep disturbance (Figure 1). [16-19]

An increased oxygen consumption and carbon dioxide production leads to increased body metabolism that occurs during concise and continued arousals stage of sleep. [18] Fragmented sleep has been associated with changes in the level of norepinephrine, epinephrine and of catecholamine. Cortisol and adreno-corticotropic hormone present throughout a 24-hour sleep–wake cycle and an increased secretion of both of these hormone have been correlated with chronic persistent insomnia. [17] The health consequences of sleep disruption have been influenced by activations of the sympathetic nervous system, the sympatho- adrenal system, and the hypothalamic–pituitary–adrenal axis. [16-19] An increased risk of type 2 diabetes mellitus (T2DM) in patients with poor sleep quality has been associated with decreased insulin sensitivity that further associated with suppression of slow-wave sleep.[20] Decreased leptin and increased ghrelin level leads to increased appetite and that again disturb the metabolic system of body which results in poor sleep quality. [21]

Immune function also associated with sleep deprivation that leads to changes in proinflammatory cytokines, such as tumor necrosis factor, interleukins 1 and 6, and C-reactive protein. [8,22] These effects of sleep deprivation are often interrelated and bidirectional. Worsening of sleep deprivation occurs due to the distress associated with sleep loss that can create additional stress to maximize sleep.[23] Researcher suggests that the mechanisms of short- and long-term health consequences are similar but are affected by time. [24] The body's ability to compensate for physiologic changes is diminished in chronic sleep deprivation that further leads to accumulating effects and basal changes. [24-25] An increased EEG activity, abnormal hormone secretion, increased metabolic activity, and increased sympathetic nervous system activity throughout the day and night occurs due to lack of appropriate body rest that further leads to sleep disorders like insomnia. This inappropriate body rest is also responsible for development of disease and various other chronic conditions.[21]

This insufficient sleep is related with alterations in the neuroendocrine stress response system that again leads to stress-related disorders such as mood disorders and depression. [25]

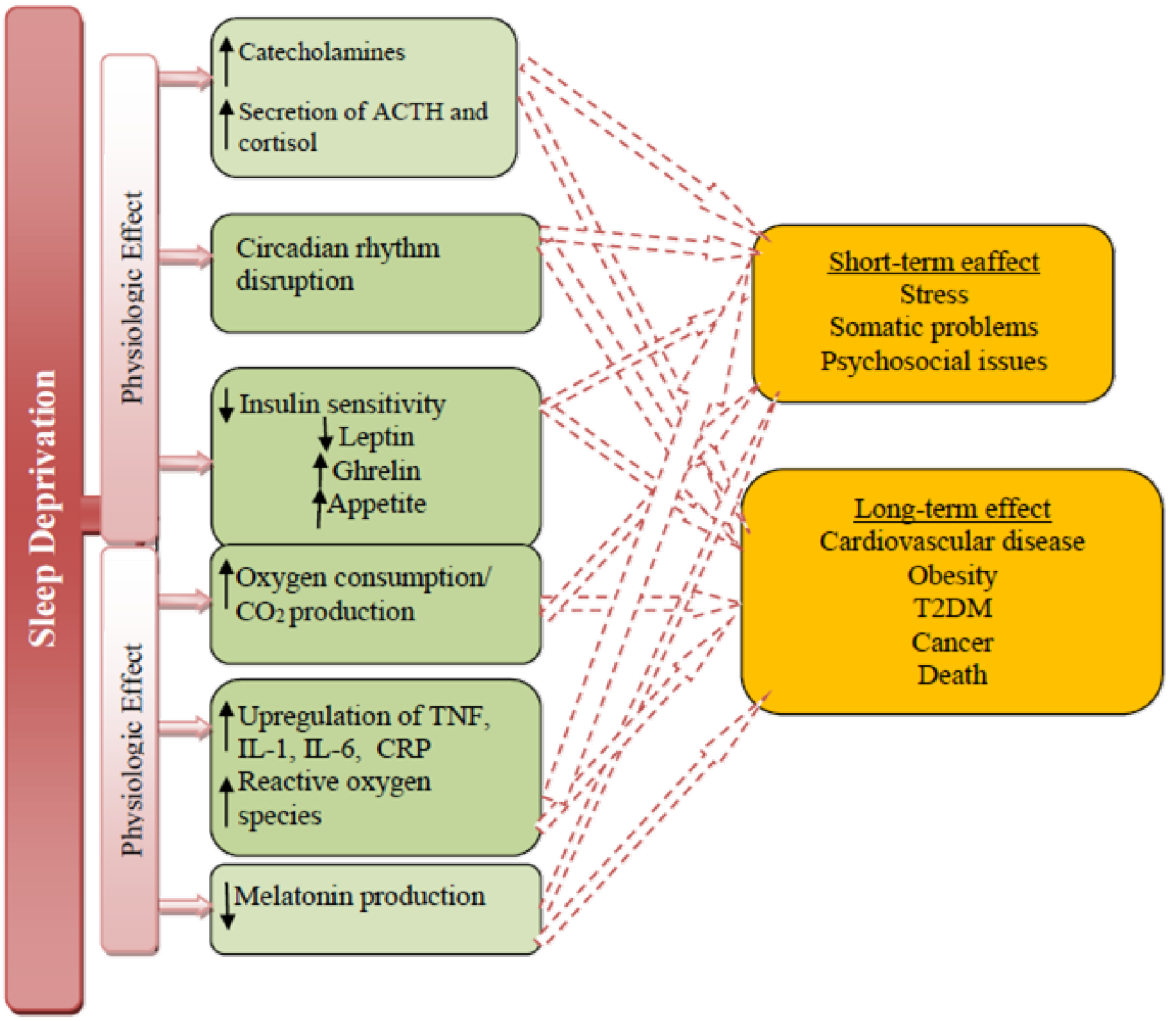

Fig 1: Mechanisms by which sleep disruption is thought to exert its detrimental short & longterm effects

Notes: ↑increase; ↓decrease. Data from the following references.[8,20,16-19, 20]

Abbreviations: ACTH, adrenocorticotropic hormone; CO2, carbon dioxide; TNF, tumor necrosis factor; IL, interleukin; CRP, C-reactive protein; T2DM, type 2 diabetes mellitus.

Table 1: As per AASM Recommended Amount of sleep

Age	Sleep Required/ 24 hours
Infant (4-12 months)	12-16 hours (including naps)
Toddler (1-2 years)	11-14 hours (including naps)
Pre-school (3-5 years)	10-13 hours (including naps)
School Age (6-12 years)	9-12 hours
Teenager (13-18 years)	8-10 hours
Adult (18-60 years)	7 or more hours per night

How Much Sleep Do an individual Need?

The National Heart, Lung, and Blood Institute (2012) describes that sleep needs change as we age and that individual sleep needs vary.

The recommended amounts of sleep hours per day are: Newborns (16-18 hours), Preschool –aged (11-12 hours), School- aged (at least 10 hours), teens (9-10 hours), Adults including the elderly (7-8 hours).[26]

As per American Academy of Sleep Medicine (AASM) and the Sleep Research Society, recommended amount of sleep required are:[27-28]

Sleep Hygiene

The CDC (2012) defined sleep hygiene as "The promotion of regular sleep". 'Sleep hygiene' is the term used to describe good sleep habits. Long-term solutions to sleep difficulties can be managed by using various strategies that has been evidence by researchers. For short term management numerous medications can be used to manage sleep abnormalities. But continuous use of these sleeping pills leads to dependence on medication and impair the developing of good sleep habits. Hence for treating good sleep habits, sleep hygiene is an important factor. [29-30]

Studies done by researchers had shown that sleep hygiene education is significantly ($p<0.001$) helpful in improving sleep quality of persons. [31] This sleep

education is correlated with avoidance of caffeine, doing regular exercise, noise free environment maintaining regular sleep schedule and many more others. [32]

Studies have shown that large dose of caffeine before bed time resulted in disturbance of sleep by blockade of adenosine receptors in the basal forebrain and hypothalamus which is responsible for increasing sleep onset latency and decreasing total sleep time, sleep efficiency. Hence, sleep hygiene practices recommend completely avoidance of caffeine especially in afternoon or evening. [33-36]

Cholinergic neurons presents in the basal forebrain and through the stimulation of these neurons, nicotine aids the arousal and wakefulness of sleep. Hence like caffeine, nicotine is also responsible for increasing sleep onset latency and decreasing total sleep time. So, as a sleep hygiene practice, it has been recommended to completely abstinence from nicotine intake. [37-38]

Alcohol intake is another factor that interrupts in good sleep habits. Alcohol also decreases sleep onset latency and increases slow wave sleep and once the alcohol is metabolized within the body, side by side sleep become lighter that further leads to increasing in Stage 1, REM sleep and more arousals. Hence, completely reduction of alcohol use has been recommended especially during bed time.[39-40]

Regular exercise encourage in sleep hygiene practice. Regular exercise helps in the improvement of sleep by producing its positive effects on body temperature, arousal, and/or adenosine levels. Regular exercise also increases in total sleep time, NREM stage 2 sleep, slow wave sleep, latency to REM sleep, and small reduction in sleep onset latency. Study has shown that more than 60 minutes of exercises increases the total sleep time at highest level. Youngstedt et al found that doing exercise close to bedtime improves sleep because of the acute body-heating, anxiolytic and antidepressant effects of exercise.[41-43] Center for Clinical intervention also recommended regular exercise for better sleep but strenuous exercise should be avoided within 4 hours of bedtime.[29-30]

Initiation and maintenance of sleep is also affected by level of stress. Researcher showed that increased stress level before and during bedtime, leads to impairment of cognitive, physiological and sympathetic arousal of the body. Relaxation and mindfulness therapy can help to minimize the stress level of the body and helps in the initiation and maintenance of sleep. [44-47]

Noise is again a precipitating factor for poor sleep habits. Various arousals in the body has been increased due to nocturnal noise and that leads to more lighter sleep, increased Stage 1 and 2 and/or suppressed slow wave sleep and REM sleep.

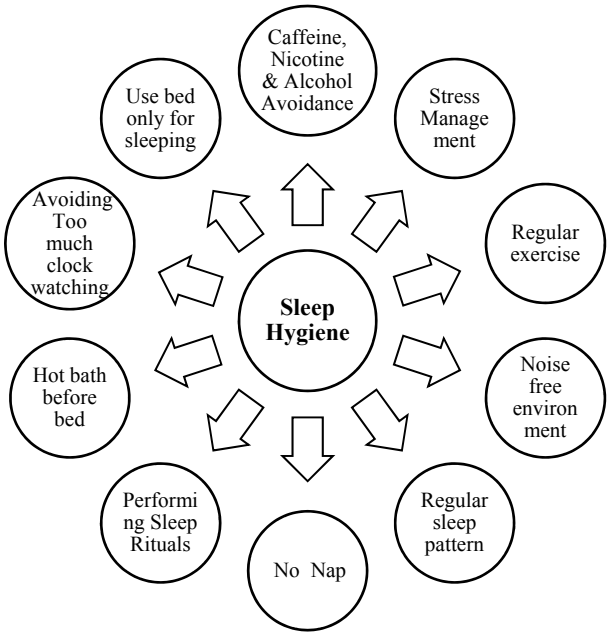

Figure 2: Healthy Sleep hygiene Practice

Noise free environment, sound-reducing and sound-masking strategies like ear plugs and white noise respectively helps in improvement of sleep quality by reducing sleep onset latency and increasing slow wave sleep SWS. [48-50]

Synchronization between physiological sleep drive, circadian rhythms, and the nocturnal sleep episode can be maintained by encouraging regular bed- and/or wake-times as a good sleep hygiene habit. This habit of going to bed and getting up at same time everyday makes a personal feel better physically as well as mentally. [29-30, 51]

It is better to avoid taking a nap in a day but if a person is not able to avoid a nap than more than 30 minutes of napping in a day should be discourage in good sleep hygiene practice and this 30 minutes of napping should be taken before 3 pm. This less than one hour of napping in a day helps to improve cognitive performance, alertness, and mood. [29-30,52-53]

Others good sleep hygiene practice includes performing sleep rituals before going to bed and it should be for at least 15 minutes. Having a hot bath 1-2 hours before bedtime also helps in improvement of sleep as hot bath raised the body temperature and this drop in body temperature encourage sleepiness in the body. Too much watching of clock is also discourage , when the person is not able to sleep as this too much watch-

ing leads to stress and that further interfere with the relaxation of body. Last but not least good sleep hygiene practice is using bed only for sleeping or sex purpose so that body will able to make a connection between bed and sleeping. [29-30,33,54]

CONCLUSION

Sleep is a biologic process that is essential for life and optimal health. Sleep plays a vital role in brain function and systemic physiology across many body systems. Problems with sleep are widely prevalent and include deficits in quantity and quality of sleep; sleep problems that impact the continuity of sleep are collectively referred to as sleep deprivation. Sleep deprivation is associated with increased activity of the sympathetic nervous system and hypothalamic–pituitary–adrenal axis, metabolic effects, changes in circadian rhythms, and proinflammatory responses. As a result of the potential consequences of sleep deprivation, health care professionals should be vigilant of how managing underlying medical conditions may help to optimize sleep continuity and consider prescribing interventions that minimize sleep disruption. Healthy sleep is essential for optimal health, performance and safety at work. Obtaining healthy sleep is important for both physical and mental health. It can also improve productivity and overall quality of life. Everyone, from children to older adults, can benefit from practicing good sleep habits. Hence, Good sleep quality is cardinal to good health, and research [55-56] has shown that it plays a fundamental role in immunity, learning, metabolism, and other biological functions.

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