

Categorizations of Major Sleep Disorders: A Literature Review

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Abstract : Various nature of waves arises in the brain during the stages of sleep. One way the stages of sleep are categorised, is, therefore, based on the nature and activity of waves originating in the brain. An analysis of the stages of sleep can provide information about the etiologies of various sleep disorders. This paper aims to create labels for classifying the different sleep disorders under broader categories. In the first section, the review of literature deals with the analysis of various stages of sleep. In the second section, the study is based on explaining the characteristics of different types of sleep disorders. Based on the review, the conclusion will be provided to integrate the findings obtained.

IndexTerms - REM sleep, Circadian rhythms, Narcolepsy, Insomnia.

I. INTRODUCTION

The stages of sleep can be categorised as per the different waveforms that arise in the brain during the various level of alertness of an individual [1]. When the individual is awake, beta waves dominate the brain. As a person enters a relaxing state, beta waves are subsequently replaced by alpha waves. Theta waves and delta waves represent the stages of sleep. The stage of sleep during which an individual witness a dream is called rapid eye movement or REM sleep. It takes approximately 90 minutes to complete one round of sleep cycle from stage I to rapid eye movement phase [2]. Circadian rhythms control the patterns of sleep. Exposure to sunlight helps an individual to wake up. Melatonin is the neurotransmitter responsible for inducing sleep [3]. The production of melatonin increases in darkness or at night. During the daytime, when the individual is exposed to the sunlight, the production of melatonin decreases. In this sense, various mechanisms of homeostasis help an individual to regulate its sleeping patterns.

Rationale of the Study

This review of literature deals with understanding the sleep cycles and categorising major sleep disorders. Although existing research has documented about various sleep disorders, this paper aims to create a classification that can act as broad categories for organing the different types of sleep disorders. Four types of waves are being analysed. They are the beta waves, the alpha waves, the theta waves and the delta waves.

II. REVIEW OF LITERATURE

Beta Waves

Beta waves dominate the regions of the brain when an individual is awake. The frequencies of Beta waves are usually higher than 13 hertz [4]. In this context, the beta waves have the highest frequencies as compared to the other waves which are related to the stages of sleep.

Alpha Waves

Alpha waves are initiated during relaxation or meditation state. The alpha waves have high frequencies and are more consistent then beta waves. Medical professionals claim that alpha waves are good for health. Another characteristic feature of alpha waves is that such waves are more synchronous than the beta waves. The frequencies of alpha wave lie in the range of 8 hertz to 12 hertz [5].

Theta Waves

Theta waves are composed of two stages. Stage 1 is composed of normal theta waves, whereas stage 2 is composed of waves having unusual amplitudes and frequencies. In stage 1, the theta waves that originate are of lower frequencies and are slower than the alpha waves [6]. However, stage 2 of theta waves are characterised by unusual waves patterns. K complexes and sleep spindles are observed in stage 2 [7]. K complexes are waves that have unusually large amplitudes, whereas the sleep spindles consist of waves that have unusually large frequencies [6]. Stage 2 is unique because it is characterised by waves having unusually large amplitudes and frequencies. This is interesting because frequency and amplitude are inversely related to each other. In other words, a wave having a higher amplitude will have a lower frequency as compared to a wave having a lower amplitude, provided all other conditions are similar. The stage 1 and 2 of the theta waves are commonly called as the light stages of sleep. Therefore, during such light stages of sleep, it is easy to wake up someone [5]. Individuals can also wake up casually by noise disturbances in the environment. The frequency of theta waves lies in the range of 3 hertz to 7 hertz [5]. The transition from alpha waves to theta waves is gradual and subtle.

Delta Waves

Like theta waves, delta waves are also composed of two stages [8]. The stages of delta waves are called stage III and stage IV, respectively. In stage III, the amount of delta waves is less than 50% [5]. In stage IV, the amount of delta waves increases by over 50%. Delta waves are the slowest waves as compared to alpha and theta waves and therefore also have the lowest frequency. These waves are associated with deep sleep of an individual. Sleepwalking and sleep talking like phenomenon are often observed during the delta stage [5]. It is worthwhile to note that the delta waves dominate the initial periods of sleep but disappears entirely during the last stages [5].

Rapid Eye Movement Sleep.

The rapid eye movement phase is accompanied by an increase in heart rate, breathing rate, and an increase in the brain's metabolic rate [9]. REM sleep activity is less during the initial stages of sleep, but the length of REM sleep increases towards the last stages of sleep [5]. This is the stage when people report to watch dreams [10]. While watching a dream, rapid eye movement is observed, and if an individual awakes just after the REM phase, he or she is better able to recall a dream [10]. The whole-body muscles are paralysed during the REM sleep phase, except for the few important ones [9]. Rapid eye movement is therefore considered to be a stage in which the body is paralysed. Sensory channels are also blocked, and no output and no motor output express. However, metabolic processes remain active. Recent studies show that areas which are involved in the processing of emotional memories show a significant increase and are more active during the REM phase of sleep [11]. The formation of memories is a complex process and can involve many areas of the brain — however, the central region of the brain that is concerned with the formation of memories is attributed to the part of the hippocampus [12].

Sleep Disorders

Four major sleep disorders which are being analysed here are Narcolepsy, Hypersomnolence, Insomnia and Apnea.

Narcolepsy

Narcolepsy is characterised by a sudden loss of control over voluntary muscles [13]. The process is so rapid that the victim may lose muscle control and collapse before they can even lie down. A distinct feature of narcolepsy episodes is the sudden transition to REM or rapid eye movement stage [13]. Therefore, individuals suffering from narcolepsy also report experiencing hallucinations during an attack as the rapid eye movement phase replaces reality. Hallucination is the apparent perception of something that isn't present, i.e. perception in 'absence of external stimulus'. Recent studies claim that narcolepsy can run in families [13]. In other words, the narcolepsy disorder carries the genetic risk of transfer of future integration. Narcolepsy most often starts in adolescence. The episodes of narcolepsy can occur for more than 20 times a day [14]. Various causes have been attributed to the occurrence of narcolepsy disorder. One of the leading causes is attributed to the regulation of Orexin neurotransmitter in the human body [15]. Orexin, also known as hypocretin, is the primary neurotransmitter responsible for the regulation of wakefulness and regulates arousal, alertness, appetite, and reward-seeking behaviours. Although there are other neurotransmitters which contribute to the state of wakefulness, orexin acts as a central player [16]. Narcolepsy can be caused due to the deficiency of orexin. A deficiency of orexin can occur if autoimmune disorders destroy the cells in the brain that produce orexin [16]. Orexin is also affected by glucose levels. The level of orexin is inversely affected by the level of glucose in the human body. As the concentration of glucose in the blood increases, the production of orexin is suppressed, and an individual feels the need to sleep [5]. Narcolepsy is divided into two types. The first type is narcolepsy without cataplexy and the second is narcolepsy with cataplexy [17]. Narcolepsy with cataplexy is also called hypocretin deficiency syndrome [17]. Cataplexy is a specific and transient episode of muscle weakness accompanied by full conscious awareness, typically triggered by emotions such as laughing, crying, sudden perception of fears etc., all of which occurs due to the destruction of the neurotransmitter orexin by autoimmune disorders [18]. Muscles during cataplexy are in the state of partial or complete paralysis. Cataplexy is thought to be triggered by emotions such as laughing, crying, or fear [18]. It is to be noted that cataplexy should not be confused with a similar term called catalepsy. Catalepsy is related to Catatonia [19], which is a form of schizophrenia [20]. Catalepsy is a nervous condition characterised by muscular rigidity and fixity of postures, regardless of the presence of external stimuli as well as the decreased condition of pain [20]. Catalepsy does not occur due to orexin neurotransmitter.

Hypersomnolence Disorder

Hypersomnolence disorder is also called as hypersomnia. Hypersomnia is a state of excessive sleepiness and is opposite of insomnia. People have trouble staying awake during the day. Such people can fall asleep at any time, for instance, at work or while they are driving. Hypersomnia can cause excessive daytime sleepiness or excessive night time sleepiness [21]. It can also cause a lack of energy and trouble in thinking clearly [22].

Insomnia

Insomnia is the state of inability to fall sleep. Insomnia occurs when an individual is unable to get the required amount of sleep or the sleep patterns of the individual routinely gets disrupted [23]. People who have insomnia have trouble falling asleep.

Apnea

In apnea, the individual has a problem in breathing during sleep [24]. Apnea is divided into two forms i.e. central sleep apnea and obstructive apnea. In central sleep apnea, the brain fails to send signals to the diaphragm that helps in breathing [25]. Another form of apnea is called obstructive sleep apnea. In obstructive sleep apnea, throat muscles become relaxed, which results in the partial

closure of the windpipe [26]. Because of this, the breathing muscles must pull in harder and therefore; the person faces difficulty in breathing.

III. CONCLUSION

The whole cycle of sleep can then be summarised as follows. When an individual is awake, the beta waves dominate the brain. Such waves have the highest frequency as compared to the other waves found during the stages of sleep. As the person enters a phase of relaxation, alpha waves tend to replace the beta waves. Alpha waves have lower frequencies than beta waves but are more synchronous and more consistent than the beta waves. The person then enters the light phase of sleep, which is characterised by theta waves. The theta waves are composed of two stages. Once a person completes the stage I and II of the theta waves, Delta waves emerge and mark the beginning of deep sleep phase. The last stage in which the person reports of watching dreams is called the rapid eye movement stage. In the rapid eye movement stage, the sensory channels are limited, and the body is in a paralysed state. Sleep disorders can, therefore, be broadly classified into three major categories. The first category is related to narcolepsy, in which the person experiences sudden attacks of sleep. The second category is related to the patterns of sleep. Two distinct disorders related to this second category are characterised by excessive sleepiness, or otherwise called as hypersomnia and inability to fall asleep or otherwise called insomnia. Finally, the third category of sleep disorder which includes apnea is related to difficulty in breathing while a person is sleeping.

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