



## An Overview of Sleep Apnea and EEG Recording

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**Abstract:** This paper is an overview of sleep apnea and recording of EEG signals. It can be used in medical practice guidelines. Sleep apnea is breaks in breathing or they are instances of deep or limited breathing during night sleep. This paper also includes the symptoms, treatment and causes of sleep apnea and types of sleep apnea. EEG recording technique can be used in sleep research. EEG recording includes computer digitization along with EEG filtering and fast Fourier transform.

**Keywords:** sleep stages, sleep apnea types, symptoms, causes, treatment, EEG recording

### I. INTRODUCTION

A sleep apnea is a sleep disorder and is enough to affect the physical and mental status of human which causes breaks in breathing or instances of deep or limited breathing during night sleeps. A break or pause during breathing during night is called apnea. Polysomnography is a test which can be used to diagnose sleep apnea and also called sleep study. It records the level of oxygen in brain, and records the breathing, heart rate and also the movement of eyes and legs. Usually polysomnography is done within a hospital at a sleep disorder unit.

### II. SLEEP STAGES

Sleep is a repeating state of rest for body and mind, in which consciousness is lost completely and eyes are closed. So, there is reduction in body movement and responses to stimuli. During sleep the brain undergoes a cycle of brain-wave activity which includes dreaming.

Stages of sleeps are classified into two parts:

1. Non-REM
2. REM (Rapid eye movement).

Non-REM stages include four stages. They are stage 1,2,3,4. Almost 50% of sleep is spend in stage 2 and 20% in REM. 30% of sleep is spend in remaining stages. Half of the sleeps of infants are spend in REM sleep. These stages start from stage 1 to REM.

Stage 1: It is a light sleep stage in which the individual can be awakened easily. Eyes moves slowly in this stage and activity of muscles slows down. People might remember the bit visual images when awakened from dream.

Stage 2: During stage 2 the movement of eye stops and brain waves slows down.

Stage 3: During this stage delta waves that are extremely slow waves starts to appear, spread with smaller and faster waves.

Stage 4: In this stage brain builds the delta waves completely. It's hard to wake up someone during stage 3 and 4. And we can also called it deep sleep stage. There is no movement of muscles and eye activity. People awakened during stage 3 or 4 would feel disoriented for some time.

**REM stage:** During this stage breathing is rapid, irregular and deep and eye moves in different directions. Limb muscles will be temporarily paralyzed. Blood pressure and heart rate increases, they often describe weird and illogical tales when they are awakened from this stage.

### III. SLEEP APNEA TYPES

The list of sleep apnea is divided into 3 parts:

1. Central
2. Obstructive
3. Mixed

Normally, instruction to the breathing muscles to take breath is given by the brain.

- Central sleep apnea: It occurs when the brain fails to send the command to the muscles for breathing and there is no muscular work is done to take breath.
- Obstructive sleep apnea (OSA): It occurs when the brain give a command to the muscles. But muscles fail because the airway becomes small and sufficient quantity of air cannot pass though the airway.
- Mixed sleep apnea (MSA): It occurs when there is both obstructive and central sleep apnea.

#### **IV. SYMPTOMS OF SLEEP APNEA**

Symptoms of central sleep apnea:

- Observed episodes of abnormal breathing or stopped breathing during sleep
- Shortness of breath accompanied by abrupt awakening.
- Shortness of breath cause the person sitting up
- Excessive sleepiness in daytime (hypersomnia)
- Difficulty in concentrating
- Change in mood
- Headache in morning
- Snoring
- Difficulty staying asleep (insomnia)

Symptoms of obstructive sleep apnea:

- Excessive sleepiness in daytime
- Loud snoring
- during sleep Observed episodes of discontinuation of breathing
- Shortness of breath accompanied by abrupt awakenings
- Awakening with sore throat or dry mouth
- Chest pain in morning when awakened
- Morning in headache
- Difficult to concentrate during the day
- Depression or irritability
- Difficulty staying asleep (insomnia)
- High blood pressure

#### **V. CAUSES OF SLEEP APNEA**

Causes of central sleep apnea:

When there is persistent (long-term) increment of carbon dioxide in blood, to determine when to take breath the brain begins to neglect the oxygen level and oversee the carbon dioxide level in blood. To acknowledge to manipulate in carbon dioxide levels control of breathing becomes slower. So when human takes deeper or more breaths and the person expel carbon dioxide the air to breathe reduces which results in reduction in rate of breathing. Because of reduction in rate of breathing, in blood carbon dioxide sets back up which increases the rate of breathing. The brain, continues to command the signal for more frequent breathing till carbon dioxide level reduces. Because of low carbon dioxide level breathing stops or slows down until the carbon dioxide level increases again. This abnormal breathing is known as Cheyne-Stokes breathing. It is repetitive cycles of slow breathing and fast breathing and apnea. This happens when human is asleep or awake, but it is more found in asleep. Some patient's experiences heart failure and they have central sleep apnea along with Cheyne-Stokes breathing.

Causes of obstructive sleep apnea:

It is a serious and common disorder in which for 10 seconds or more breathing stops. It results in decreased level of oxygen in blood and can awaken person throughout the night. OSA has different causes.

In adults, the common cause of OSA is obesity and excess weight, which is related with soft tissue of throat and mouth. During night sleep, when throat and throat muscles are relaxed, the airway is blocked because of this soft tissue. But there are many other factors which are associated with causes of OSA condition in adults.

In children, causes of OSA often include enlarged adenoids and tonsils. And can be dental conditions like enlargement of overbite. Less common causes include growth in the airway or a tumor, and down syndrome which is a birth defect or Pierre-Robin syndrome. Enlargement of the adenoids, tonsils and tongue are caused by down syndrome and in the upper airway there is decrease in muscle tone. Pierre-Robin syndrome causes tongue to ball up and fall to back of the throat it has actually smaller jaw.

#### **VI. TREATMENT OF SLEEP APNEA**

Treatment of central sleep apnea:

In infants, an apnea alarm is used to treat CSA. It uses sensors to monitor the infants breathing and sounds loudly when apnea is detected. The alarm easily wakes the parents and the infants. Most infants out-grow the central apnea episodes, after resolving the episodes the alarm is stopped. In infants with by birth problems, for longer period apnea monitoring may be required.

In adults with CSA, it can be treated by treating the high altitude, medication interaction, heart disease, or other problem.

Treatment of obstructive sleep apnea:

1. Change lifestyle like lose weight.
2. Continuous positive airway pressure (CPAP) is a machine that enlarges the airways and helps to keep them open so that the person can breathe properly without any interruptions
3. Oral breathing devices: Devices like nasal dilators that the person has to wear at night. The valve region and the part of the nose were dilated with a plastic device.

## VII. EEG RECORDING

Electroencephalography is used to monitor the electrical activity of brain by placing the electrodes along the scalp. It measures and records the voltage fluctuations which results from ionic current within the neurons of the brain. It can be used to diagnose tumors, sleep disorders and strokes. Usually 20–40 minutes of brain activity is recorded from multiple electrodes by placing it on the scalp of the person. Generally diagnostic applications focus on the spectral collection of EEG which is observed in EEG signals and is the type of neural oscillations. In neurology, the diagnostic application of EEG is epilepsy. On a standard EEG study it can create clear abnormality. A major use of EEG is in the diagnosis of brain deaths, encephalopathies, and coma. A third use of EEG is for the studies of sleep disorders and sleep where recordings are done for one whole night, sometimes it may increase but this use is decreasing with the beginning of anatomical imaging techniques such as MRI and CT with high (<1mm) spatial resolution. In spite of limited spatial resolution, EEG still continues to be a important tool for diagnosis and research. Generally EEG waveforms are divided according to their amplitude, shape and frequency. The classifications of waveforms are as follows

Table 1: Categories of EEG signals

Type	Frequency(Hz)	Amplitude	Location
Delta	1-4	20-400 $\mu$ V	posterior in children, frontally in adults
Theta	4-8	100-500 $\mu$ V	Found in locations which is not linked to task at hand
Alpha	8-13	2-10 $\mu$ V	Posterior locations of head, both sides, larger in amplitude on non-dominant side. Central sites (c3-c4) at rest
Beta	13-30	1-5 $\mu$ V	Symmetrical distribution, both sides, most evident frontally, low amplitude waves

## VIII. CONCLUSION

The outline of this review is an overview of sleep apnea and EEG recording that can be used to diagnose the sleep apnea. In society, sleep apnea is common and general physicians should have a high index of consideration about it. Sleep disorders once tested and then can be treated best by a sleep specialist. EEG recording technique is used to measure the brain activity, where there is no introduction of instruments into the body. It can be used in almost any environment and has high time-resolution. Therefore EEG is an interesting technique to study brain activity including sleep apnea.

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