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Review Article

Analytical Study of EEG Brain Waves in Different Psychiatric Disorders

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Abstract

The emerging psychiatric disorders worldwide is demanding a quick, safe diagnostic measures to provide a good healthcare to the patient. The psychiatric disorders are still diagnosed based on DSM criteria. It is useful but can we find some noninvasive, quick diagnostic measures which can take less time and can give more authentication to the diagnosis that is based on DSM criteria.

Electroencephalogram [EEG] is a noninvasive, low-cost technique to read the brain waves but its capability to be used in psychiatric disorders are yet under the shadow. We have compiled clinical trials and meta-analysis and discussed how EEG results in different psychiatric disorders can be helpful in the diagnosis.

Keywords: *Electroencephalogram [EEG]; Psychiatric Disorders; DSM Criteria*

Introduction

Psychiatric disorders are most common disorders that widely distributed yearly. They are known in many ways regarding studies that divided them into groups of disorders. psychiatric disorders are Major depressive disorder (MDD), autism spectrum disorder (ASD), anxiety disorders, obsessive compulsive disorder (OCD), attention deficit hyperactivity disorder (ADHD) and many disorders under discovery as well. psychiatric disorders had shown similarity in symptoms between some of them as bipolar disorder and depression or schizophrenia. Regarding that, studies involved had used electroencephalogram (EEG) to detect brain changes in activity and waves as to use it in future as essential diagnostic biomarker. EEG had proved its effect and is used as gold standard for accurate diagnosis due to its ability in detecting brain waves changes in each psychiatric disorder. Additional to that, EEG had detected brain waves activity changes in many psychiatric disorders. These facts were regarding studies in psychiatric patients as well compared in control group.

EEG studies

Electroencephalography (EEG) was first discovered in 1875 by Richard Caton a physician practicing in Liverpool as he presented his findings about electrical phenomena of the exposed cerebral hemispheres in both rabbits and monkeys in the British Medical Journal. Forward to that, in 1890 a Polish physiologist known as Adolf Beck had published an investigation of spontaneous electrical activity of the brain of rabbits as well dogs that included rhythmic oscillations altered by light. Adolf Beck placed electrodes directly on the surface of the animal's brain to test sensory stimulation. His observation of fluctuating brain activity led to the conclusion of brain waves. By time,

in 1912, Ukrainian physiologist Vladimir Pravdich-Neminsky, published the first animal EEG and the evoked potential of the mammalian while Napoleon Cybulski in 1914, photographed EEG recordings of experimentally induced seizures. Hans Berger was the first human that recorded EEG on humans in 1924 but it was published in 1929 [2,3].

EEG is a tracing of voltage fluctuations versus time recorded from multiple electrodes that placed over the scalp in a specific pattern to sample different cortical regions. Additional to that, it represents fluctuating dendritic potentials from superficial cortical layers, which are recorded in an organized array pattern and require voltage amplification to be captured. EEG had been used and still used for variety of neurological disorders as epilepsy. It is known that EEG is produced by pyramidal cells of the brain cortex. Moreover, EEG is a method can detect brain waves changes as well [2,3].

EEG procedure is mainly containing a total of 21 electrodes that are typically used in detecting brain waves. Next to that, doctor will put the electrodes in the right place on your head as the electrodes and cables are attached to a cap that is pulled over your head. Note that before the test the electrodes are coated in a special gel that makes it easier to measure the electrical activity. Doctor will advice before EEG that your hair should be clean and free of residues from products such as styling foam, gel or hair spray. During the measurement, you should lie or sit in a relaxed position and stay calm as possible. Additional to that, an assistant with the doctor will give you directions as open your eyes or to take deep breaths. During the procedure, doctor will check EEG as it shown as video and repot what he or she can see. The recording takes about 20 to 30 minutes. After the procedure EEG will detected your brain activity and waves as doctor will print it on a paper [5].

Brain waves are known as delta, theta, alpha, beta, gamma and mu. Delta rhythm (0 - 4 Hz), this wave is recorded during very low activities of the brain and deep sleep. Theta rhythm (4 - 7 Hz), it is recorded during low brain activities, sleep, or drowsiness. This wave is recorded when the eyes are open. Alpha rhythm (7 - 13 Hz), it originates from occipital lobes during wakeful relaxation. It has higher amplitude on the dominant side. Beta rhythm (13 - 35 Hz), this wave is related to brain activities, consciousness and motor behaviors [4].

Abnormal waveforms seen in an EEG recording divided into two groups, epileptiform and non-epileptiform abnormalities. Non-epileptiform Abnormalities are slowing, focal slowing and diffuse slowing. Slowing: it indicates cerebral dysfunction as it described as 'polymorphic' based upon the shape of waveforms and 'rhythmic' based upon the frequency. Slowing can be either diffuse or focal, depending on the location or extent of the brain involved. Next to slowing, diffuse slowing which indicates global cerebral dysfunction. The slowing can be in the theta or delta ranges as well it can be high or low amplitude. Focal slowing indicates focal cerebral dysfunction. This can be continuous or intermittent as continuous focal slowing is often indicative of structural abnormalities and can be seen in conditions like brain tumors, stroke, traumatic brain injury, intracerebral hemorrhage, while intermittent focal slowing can be of the following types based on the location of the slowing, Frontal intermittent rhythmic delta activity (FIRDA), Occipital intermittent rhythmic delta activity (OIRDA) and Temporal intermittent rhythmic delta activity (TIRDA) [2,3].

Epileptiform are many, Spike and wave which are very short in duration, with a sharp-pointed peak duration of 20 to 70 milliseconds. The spike is mainly followed by a wave component ant it is generated by GABA-b mediated currents. Moreover, Sharps are longer in duration compared to spike and last 70 to 200 milliseconds. Additional to that, 3 Hz and spike-wave are typical for absence seizures but can also occur in other types of generalized seizures.

Centro-temporal spikes/Rolandic spikes are seen in benign focal epilepsy of childhood with centrotemporal spikes (BECTS). Epileptic encephalopathy with continuous spike-and-wave during sleep (CSWS), both continuous spike and wave activity is seen during sleep, as well it can be seen in many different seizure subtypes and epilepsy syndromes. Poly spike and waves, a complex of repetitive spikes is noted, followed by a wave component. These are seen in generalized epilepsy and less commonly in focal epilepsy. Generalized polyspikes

and waves are commonly seen in myoclonic epilepsy. Examples of myoclonic epilepsy include Juvenile myoclonic epilepsy and progressive myoclonic epilepsy. Polyspike and wave discharges have a frequency ranging from 3.5 Hz to 5 Hz and termed fast spikes and waves. They show a bifrontal predominance. Myoclonic epilepsy predominantly involves the upper extremities, though it can involve the lower extremities. Photic stimulation often activates these discharges. Generalized spike and waves, a single spike is noted and followed by a wave component. These are seen in primary generalized epilepsy. Lateralized periodic discharges (LPDs or PLEDs) are repetitive focal discharges that occur at regular intervals. LPDs can be seen with focal structural lesions, usually acute [3].

Brain waves in Tourette syndrome

Tourette syndrome (TS) is a neuropsychiatric disorder in childhood that characterized by occurrence of both vocal and motor tics. These tics are involuntary, repetitive, stereotyped movements and vocalizations that occur in bouts, typically many times in a single day, additional to tics, premonitory urge (PU) is reported in TS patients. PU is uncomfortable cognitive or bodily sensations that occur prior to the execution of a tic and experienced as a strong urge for motor discharge. TS is often accompanied by obsessive compulsive disorder (OCD), attention-deficient hyperactive disorder (ADHD), poor impulse control and other comorbid behavioral problems [6,8].

Factors that contributing to TS are frequent inclusion of patients under psychiatric treatments and cognitive-behavioral therapy (CBT) or deep-brain stimulation (DBS) can affect neuropsychological functions as well. The etiology of Tourette Syndrome is idiopathic, while the pathophysiology mechanism is quite understandable. The pathophysiology in TS is due to cortico-striato-thalamo-cortical (CSTC) circuits. This is mainly as these circuits assure the communication between subcortical structures, such as the basal ganglia and the cortex. Noticing the basal ganglia function which receive inputs from the whole cortex. These inputs are mostly motor, limbic and associative. These inputs are mostly motor, limbic and associative. Additional to that, they stay parallel throughout their projections to the basal ganglia and this segregation leads to the advent of functional loops: the CSTC circuits. Regarding that, there are some cross-connections between different circuits that allow the integration of information. Five different CSTC loops have been identified: (1) motor, (2) oculomotor, (3) prefrontal, (4) orbitofrontal and (5) cingulate circuits. These circuits are involved in multiple cognitive functions like error detection, planning, movement execution or inhibition, motivational regulation of behavior and associative learning. Each of these circuits is divided mainly into two loops: first, the cortico-striatal, second, the cortico-subthalamic circuits. The first circuit receives input from the whole cortex. Contrary to that, the second circuit receives only motor input from the frontal cortex. Impaired functioning of the cortico-striatal circuit might lead to reduced inhibition from thalamus nuclei, which could result in involuntary movements. Studies showed that tics might be caused by unexpected activation of striatum cells that can lead to the production of unwanted movements. Additional to that discovery, thinning of the sensorimotor cortex was found in TS patients [8].

Diagnosis of TS is not challenging regarding its distinguished symptoms that don't need diagnostic biomarkers to confirm the presence of TS. Although this fact, many studies were involved in understanding about brain changes in TS patients specially during the tics and PU. Studies had used many tools; the gold standard is electroencephalographic (EEG) which contribute in detected brain waves changing with TS. EEG is non-invasive, safe and easy to apply and thus it provides an adequate means to investigate brain dynamics during the brain maturational period. One of the involved studies had done with control study. Studies were done on 45 cases of both TS and healthy individuals. This study had detected elevated incidence of EEG abnormalities on TS patients. Abnormalities were varied, but the presence of sharp waves and slowing waves was most found in TS patients. Additional to that, EEG reported Photoconvulsive discharge, Polyspikes and Increased cerebral excitability. Conducting to that, the primary and secondary voltage, abnormal features, seizure activity, responses to hyperventilation, focus of any abnormal activity and photic stimulation were also detected [9].

	Normal	Tourette syndrome
Cases	20	25
Sharp waves alone	0	9
Slowing	0	4
Sharp waves + slowing	0	8
Photoconvulsive discharge	0	2
Polyspikes	0	1
Increased cerebral Excitability	0	1
Seizure discharge	0	0

Additional studies involved, had used EEG during their studies in order of detecting brain waves changes in TS. This study had many groups of TS patients regarding their age. TS-twins had shown on EEG that the twin with the more severe course of illness had significantly more fronto-central theta activity. Additional to that, 36 patients of TS had a decreased intrinsic long-range connectivity between the frontal and the temporal/occipital/parietal lobes. In control studies, TS patients were showing reduction of EEG complexity mainly in lower frequencies. Additional to that, in control studies and specially during tics, EEG detected increased oscillations in the theta/beta band at fronto-central areas which in turn suggesting a fronto-motor interaction of cortical oscillations [10].

Brain waves in major depressive disorder (MDD)

Major depressive disorder (MDD) or depression is a neuropsychiatric multidimensional disorder that increase its percent yearly. MDD is characterized by the presence of alterations in mood as lack of energy or loss of interest, cognitive capacity, difficulty concentrating, uncontrol sleep, loss appetite, sensorimotor and homeostatic functions. Depression can be for short time due to life stress or long period of time with suicidal thoughts that consider as MDD.

Depression is increase day by day regarding life stress without taking care of its symptoms. MDD pathophysiology or the etiology of it that some individuals can have MDD while others not is unknown yet. Although that, it was thought to be as a genetic cause or brain alternations due to frequent stress. Additional to that, it was noticed that about half of the patients that diagnosed with MDD do not respond to the various current treatments. Available techniques like repetitive transcranial magnetic stimulation (rTMS), electroconvulsive therapy (ECT), or deep brain stimulation (DBS), additional with antidepressants are the most useable treatments. Regarding that, many studies had started using methods in order of understanding the pathophysiology of MDD [11].

Electroencephalogram (EEG) is a non-invasive method that used to record an electrogram of the electrical activity as brain activity and brain waves on the scalp. There are 5 main brain wave frequencies that are measured by an EEG which include alpha (8 - 13 Hz), beta (14 - 30 Hz), delta (0.5 - 4 Hz), theta (4 - 8 Hz) and gamma (> 30 Hz). Each of them is associated with different states of activity and consciousness within the brain. studies contributed in depression understanding had used EEG to detect brain waves change in MDD patients [11,12].

Gamma waves are the fastest brain waves and mainly it occurs when an individual is highly alert and conscious while also having high levels of thought and focus. Studies in Gamma waves described if the brain produces lower levels of gamma waves, memory and learning issues may arise. Regarding that, studies has shown that the amplitudes of gamma waves may be a contributing factor of depression. The examinations of the link between gamma oscillations and major depression is still being under studying [12].

Alpha waves (α) are electromagnetic oscillations with a frequency range between (8 and 13 Hz). Alpha waves are recorded in posterior regions and with eyes closed during wakefulness. These waves are related to states of relaxation. Electroencephalographic records, most studies proposed that subjects with MDD that shows left frontal cortical hypoactivation, that is, greater left frontal activation α. Additional to that, EEG studies on alpha waves in depression have shown low frequency bands in alpha waves [11,12].

Theta waves (θ) is one of the brain rhythms is reflecting activity from the limbic system and hippocampal regions. It observed electrophysiologically altered in MDD in both during the course of the disease and before and after therapeutic intervention. This activity is composed of waves of different morphology (regular or irregular), with a frequency of 4 to 8 Hz. Additional to that, it is observed in the temporal regions as well it is related to various memory processes like working memory.

The frontal rhythm θ has been located in the ACC,83 which considered as an important brain area in emotional and behavioral control while rostral ACC (ACCr) represents a fundamental region in the neurobiology of depressive disorders. The anomalies found in theta band was unfortunately disappointed due to disparate results. This disappointment was due to in most studies indicate that this disorder would be associated with increased activity of theta in ACCsg. Since activity in this region is involved in the resolution of emotional conflicts, it has been considered that its hyperactivity in MDD could reflect a compensatory activity of fronto-cingulate neural networks that mediate and regulate emotional aspects. Contrary to that, studies have also been found in which MDD seems to be more associated with a decrease in activity of theta waves regarding the suggesting of which the alteration would evidence a functional disconnection in such networks altering the emotional processing capacity [11].

Brain waves in post traumatic stress disorder

Posttraumatic stress disorder (PTSD) is one of the anxiety disorders that develops in individuals who have experienced or witnessed traumatic events. These traumatic events occur at any age as well at any time, it affects some individuals to have PTSD episodes. PTSD Traumatic events include child abuse (physical, sexual, emotional), accidents, life-threatening illness, death of a family member. Additional to that, children having community or school violence or in war time may suffer from PTSD. Usually, such individuals develop various symptoms like recurrent/intrusive thoughts (nightmares, flashbacks), avoidance and hypervigilance. Symptoms of re-experiencing include recurrent nightmares, physical responses to trauma cues and/or sensations that the trauma is continuing to 1 month and more.

Diagnosis of PTSD is dependent on the DSM-5 criterion majorly but can also be determined by detecting abnormal brain activity. It is difficult to diagnose PTSD due to its similarities with other anxiety disorders as panic attacks. Additional to that, many PTSD patients are mostly silent about their symptoms and shy. Regarding the missing of pathophysiology with etiology not clear, studies should be done in understanding and differentiate as well between PTSD and other overlap disorders [13]. Studies noted that, certain brain structures are related to characteristics of PTSD. These structures are generally responsible to the regulation of the Hypothalamus-Pituitary-Adrenal Axis (HPA) and associated with stress and memory. This axis is involved in 3 organs, Hypothalamus, Pituitary gland and adrenal gland. Stressful situations s impact on the amygdala and hippocampus (which are part of the limbic system) as well as the Prefrontal cortex region (PFC). Studies had shown the impact of amygdala and hippocampus regarding control studies, that shows differences between normal individuals and PTSD patients. The amygdala as well as the middle-anterior cingulate cortex, had showed increased activity in individuals with PTSD. Regarding hippocampus, reduced hippocampal volume and activity are also associated with PTSD. Not only the hippocampus, but hypoactivity of other regions like the orbitofrontal cortex, right inferior frontal gyrus as well as regions of PFC may occur [14,18,19].

According to recent studies, many studies were involved in detected brain activity and waves changes in PTSD patients. Studies detected that PTSD is associated with rapid waves [15]. Specifically, the difference in waves detected in the frontal lobe, which is associated

with negative feelings, are characteristic in PTSD. There is a greater right frontal alpha asymmetry depicted in EEG recordings which acts as a diagnostic biomarker [13-15]. This asymmetry is greater in individuals who have had interaction with adverse life events [14]. This is also related to stronger emotional and physical reactions to triggers as well as severe PTSD symptoms [13].

With respect to brain waves, the dorsolateral prefrontal cortex (DLPFC) is important. Lateralized DLPFC dysfunction may occur based on individual complexity of symptom clusters. Stronger left delta and theta band powers are related to negative cognition and mood. Stronger right alpha and beta band powers are related to direct exposure to traumatic life events whereas a relatively stronger right left-right imbalance of the alpha, beta and theta waves is associated with hyperarousal symptoms. Early childhood adversity may lead to a stronger presentation of PTSD symptoms and a stronger left-right imbalance of the delta, theta, alpha and beta waves [14]. Some studies show an increased beta and decreased alpha rhythm in individuals with a long history of PTSD [15]. Along with this, decreased theta and delta bands are also prominent in individuals who have experienced traumatic or stressful events in childhood [16].

Another important region of the brain is the insula, which plays a major role in psychological stress. Studies show a reduced volume of gray matter density in the left insula. Abnormal slow waves are also seen in this region, as well as increased regional cerebral blood flow in certain parts [20].

EEG's can also be used to measure Event-related Potentials (ERPs) which are shown in the form of positive and negative voltage deflections. A study showed positive deflection abnormalities (P2) in individuals with PTSD who have experienced physical or sexual abuse [21].

In conclusion, it can be seen that various brain waves are associated with various symptoms which help in studying the neuropsychological aspect of PTSD. The most prominent deviations are in alpha waves, whereas different studies have depicted variations in other fast and slow waves. As theorised by William J. Bosl, EEGs may be used for early detection and tracking of abnormal brain changes throughout an individual's life [17].

Brain waves in Attention deficit hyperactivity disorder

Attention deficit hyperactivity disorder (ADHD) is a well-known neurodevelopmental condition that affects people's behavior by characterizing patterns of inattention and hyperactivity that could lead them to act impulsively. Most often, it is discovered when the child is young and has symptoms like short attention span, lack of focus and physical restlessness. It negatively impacts the essential daily activities, including social, academic and professional lives [22]. Their ability to focus is less and they appear to be disorganized at times, making it difficult to complete a task. This disorder is chronic and has no age restrictions that can last until death. ADHD is not fully clear its etiology as well the pathophysiology mechanism of it. Regarding that studies involved should take part in understanding the pathophysiology of ADHD [22,23].

Studies reveal that their brain functions differently from a typical brain. Due to the specific brain circuits functioning normally, the cortical regions involved in attention, impulse control and input integration have not been fully activated yet. ADHD appears to be a genetic impulsive illness due to the imbalance of neurotransmitters [23]. Additional to that, studies also have revealed variance in brain waves in persons with ADHD, according to Lubar (1991). Theta/beta wave ratio analysis of ADHD patients, which is mostly the case with EEG (Electroencephalogram), is one of the future promising tests that have been used to diagnose ADHD for decades [24,25]. EEG detected theta waves (associated with relaxation) are in a high state, whereas beta waves (associated with concentration) are in a lower state than the normal state. That increase the clarity why people with ADHD have trouble focusing constantly, solving problems and dealing with challenging situations [22]. But most researchers have shown concerns about the reduced power in alpha and beta bands and an increased

power in delta and theta bands. When cognitive difficulties occur, it might sometimes seem paradoxical that the alpha power in children with ADHD would increase while it declines in the control group [25].

Theoretically, this imbalance may arise when an individual with ADHD fails to deactivate action in the default setting network during cognitively demanding tasks [22,25]. According to EEG, this spontaneous occurrence is a low-frequency activity and children with ADHD showed very little attenuation of EEG frequency during the transition from rest to task [Helps., *et al*.]. additional to EEG findings, Fascinating investigations employing functional magnetic resonance imaging (MRI) have revealed that stimulant medicine (methylphenidate) appears to have improved the inhibition of default mode activity in the ventral anterior cingulate cortex [22].

Brain waves in Obsessive Compulsive Disorder

Obsessive Compulsive Disorder (OCD) is a neuropsychiatric disorder that can be due to both environmental and genetic risk factors. It is associated with obsessions and/or compulsions [26]. OCD is characterized by troubling thoughts (obsessions) and repetitive, ritualistic behaviors (compulsions). increase in anxiety and distress increase in OCD patients when an obsession occurs. In order to decrease obsession, it is recommended to follow rules as washing hands, counting, repeating and straightening. It is known that regarding studies OCD affects male heavily compared to woman. OCD differs in male and female regarding symptoms as in male it is mostly contributed with GAD while in female OCD is contributed with anxiety disorders as PTSD, nail biting and skin picking [34].

Studying the differences in wave-frequencies in patients with OCD and a healthy population can give us some useful electrophysiological markers for diagnosis and treatment in the future. Numerous EEG investigations signify that OCD is related to frontal lobe disturbances. In an analysis of EEG frequency in OCD patients, the major differences were observed mainly in the frontal lobe. The frontal lobe had a decrease in the Maximum alpha frequency and Modal alpha frequency, whereas the temporal and occipital lobes showed no noticeable alterations [27]. In another study, when all alpha, beta, theta and delta band frequencies were calculated, EEG background activity was found to be slower in OCD patients, especially in the frontal lobe. Alpha and beta frequencies were decreased whereas delta frequencies had an increase [28]. Based on certain studies, OCD patients had higher theta band frequencies in the fronto-temporal area [29] and fronto-occipital area [30,31] than healthy controls. Some researchers also found a rise in delta band frequency in anterior and middle cingulate [32]. These increases in delta and theta band frequencies are related with cognitive processing in OCD patients [30,33] and can be considered as a significant marker in OCD patients.

We can conclude that the majority of these EEG analysis studies have same baseline findings that alpha and beta band frequencies are reduced whereas theta and delta band frequencies are increased in the frontal region. These results also provide evidence for frontal lobe dysfunction in OCD patients [27-30]. The role of the frontal lobe in the pathogenesis of OCD can help us in finding a discrete physiological basis in the upcoming years.

Discussion

Psychiatric disorders (PDs) are considered nowadays one of the important disorders that need concentration to it regarding the fact that its yearly increasing number in population. PDs are many as mood disorders (schizophrenia, bipolar disorder). major depressive disorder (MDD) knows as depression, anxiety disorders (PTSD, panic attack, panic disorder), eating disorders, attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD) and catatonia, with respect to other disorders that under discovery and confirmation in our century. Symptoms were in most of them common as depression, lack of energy and concentration. Others like panic attack may have an fear episode that vary in severity from crying to faint. Regarding autism and ADHD both are chronic mental and psychiatric disorders that you can see behavioral changes as a usual behave for them.

Discovery of these disorders and differentiate between them wasn't that easy and available as nowadays. This fact is mainly due to the similarity of symptoms between most of them. Additional to that, the absent of understanding the etiology and pathophysiology in many of them was obstructive in diagnosis way with many scientists. Regarding that, studies involved were taking part in understanding and differentiate had used available diagnostic tools and radiological in order of more understanding. EEG was a gold standard diagnostic biomarker.

Many studies had used radiological tools as MRI to detect brain structures changes. It was a good method but not with all of psychiatric disorders. MRI detected changes in ASD as many of them shown enlarged hippocampus. Additional to MRI, genetic tests were helpful in detecting the future child may suffer from psychiatric disorder or no. Contrary to that, the gold standard biomarker were used and still used nowadays is EEG. Electroencephalogram (EEG) is a recording of brain activity and detected changes in brain waves compared to healthy individuals. EEG had detected changes in both brain activity and brain waves in all discovered psychiatric disorders. Moreover, it had ability to differentiate well between many similar PDs. These dictations were seen in reduce or increase in brain waves (alpha, beta, delta, theta and mu) and length and shape changes in brain waves as sharp waves in Tourette's syndrome. Concluding EEG impact, it has great results in diagnosis of psychiatric patients.

Psychiatric disorders	Brain waves abnormalities
Tourette syndrome (TS)	Sharp waves with/without slowing
Major depressive disorder (MDD)	Decrease activity of theta waves Low frequency bands in alpha waves
Post-traumatic stress disorder (PTSD)	Rapid waves
Attention deficit hyperactivity disorder (ADHD)	Elevated in delta and theta bands Reduction in alpha and beta
Obsessive compulsive disorder (OCD)	Beta and alpha band reduction Increase delta band Slow EEG background

Conclusion

Studies results in EEG involved studies with psychiatric disorders had summarized that EEG is a gold standard tool in detecting changes in psychiatric disorders. Additional to that, EEG is used as diagnostic biomarker for accurate diagnosis between psychiatric disorders with similar symptoms. these fact regarding many studies had ease in understanding many disorders which helped in early detected of them as well having the proper treatment.

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