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REVIEW STUDY FOR MIGRAINE IDENTIFICATION USING BRAIN SIGNAL ANALYSIS

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Abstract

Migraine is a neurological disease characterized by pulsating pain on one side of the head. Sometimes it is accompanied by sensory and visual symptoms. The symptoms may worsen and turn from an occasional headache to a chronic headache. In some cases, it develops into other diseases such as epilepsy and stroke, which affects the health of the individual and society, causing the loss of many working hours. Therefore, the researchers proposed several ways to diagnose this disease ccombined with machine and deep learning techniques in order to advance the health situation and develop the medical care provided to the patient away from traditional methods that are usually cumbersome and take a long time. These methods include recording brain signals and analyzing them to extract distinctive features and benefit from them later in diagnosing and classifying the disease. As well as the MRI method) magnetic resonance imaging (of the brain to detect changes occurring in the functional connectivity of different brain regions associated with pain. So, the primary aim of this review was to evaluate the effectiveness of machine and deep learning algorithms to predict and detection migraine and its types from EEG and MRI method. The results show that deep learning has the ability to predict migraines based on EEG, which could eventually be used to assist in clinical care. Based on the resting state, CWT method, and AlexNet classifier, the scenario, approach, and model that demonstrated the greatest successful performance for early diagnosis of migraine (99.74%) were determined. We believe that the results of this study are encouraging and useful for early detection of migraines based on electroencephalogram (EEG).

Keywords: *Migraine Identification,* Brain Signal Analysis.

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1. Introduction

The Migraine is complex anxiety in the brain network and has a strong genetic basis, causing interactions between multiple nervous systems and a wide range of symptoms. [25], Such as increased sensitivity to light, sound, touch, and smell [1]. As well as trigger factors, such as certain hormones and psycho-physiological stress [41]. And it affects approximately 1 billion people, This implies social and economic burdens and absenteeism from work and study [32]. There are various forms of the migraine, each with overlapping but unique clinical symptoms. For example, one-third of migraine patients have short neurological symptoms that occur prior to some of their episodes, known as migraine symptoms, which include visual, tactile, motor, and/or speech difficulties. Strong and long-term evidence supports brain involvement in the pathogenesis of auras. [1]. Most importantly, it is the third most widespread disease, it is worth mentioning that migraine ranks seventh globally in the list of the most disabling diseases and the first among neurological disorders. [7].

MwA (Migraine with Aura) It seems more related to anxiety and epilepsy than migraine without aura. MwA also increases the risk of vascular illnesses like stroke and may be associated with silent brain damage. Based on clinical findings of the slow spread of migraine aura symptoms, which corresponds to a velocity of around 3 mm per minute, cortical spreading depression (CSD) has been proposed as the pathophysiology correlate of migraine aura [14]. Although headaches are typically a benign and transient anxiety that resolves on its own or with painkillers, they may also be brought on by a dangerous illness that poses a major risk to life, such as meningitis, cerebral edema, high cholesterol, heart issues, or subarachnoid hemorrhage (arteriovenous malformation). However, even if they are benign, some kinds of headaches, including migraines, inflict a great deal of suffering for those who suffer from them and pose an economic challenge due to the enormous number of lost working hours, particularly when the migraine progresses from episodic (EM) to chronic (CM) [5].

Since examining the patient by asking him about the symptoms and relying on the doctor's experience is cumbersome, takes a long time, and may not be accurate in many cases , While behavioral tools are valuable, there is a need to develop more individual clinical care, as many traditional methods fail for individuals who cannot accurately express their pain, such as those with dementia. [27].

Because the diagnosis of migraine is based on a set of symptoms and it is difficult to rule out potential causes, traditional procedures (such as assessing symptoms and medical tests) are insufficient**.** [11]**.** If presentation is atypical in addition, untreated attacks may last from 4 to 72 hours, affecting the patient's life and the general health of the community, In recent years many machine learning techniques have been explored, Deep Learning (DL) techniques have also been successfully engaged to solve disease diagnosis problems [28]. There are also two methods that have received great attention for studying neural mechanisms to diagnose migraine and distinguish between its types like: EEG (electroencephalogram) and FMRI (Functional Magnetic Resonance Imaging) with the help of machine learning. Recent studies have proposed that EEG is the commonly used [9].

1.1. EEG overview

The Electroencephalography is a low-cost, non-invasive, neuro-electrophysiological technology that has been widely employed in both the medical and non-medical domains. [19]. EEG records brain electrical signals with the reference of time; these signals are much complex and messy in nature [26]. EEG microstate analysis can evaluate the functional state of the brain in the sub-second time scale, with very high temporal resolution [18]. The patient's brain signals are recorded by placing electrodes on his head according for 10–20 the International Electrode Positioning System EEG as illustrate in figure (1) below.

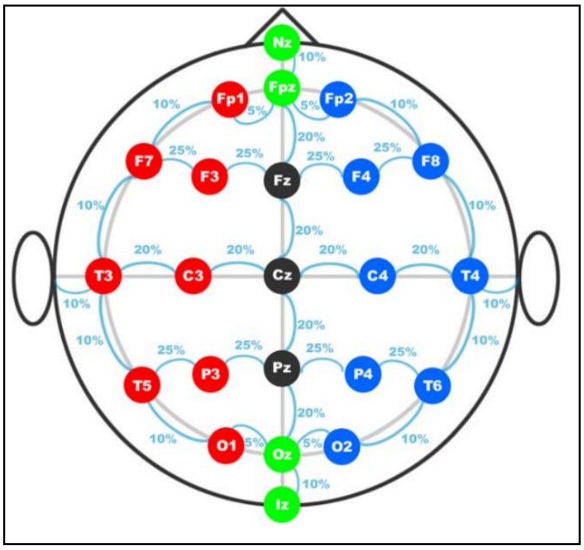

Figure (1): EEG electrode placement. https://trans-cranial.com/docs/10_20_pos_man_v1_0_pdf.pdf

The Electroencephalogram (EEG) records help in recognition of dysfunctional neural dynamics of Alzheimer's, Epilepsy and Migraine diseases [21]. Therefore, electroencephalography (EEG) has become a critical and non-surgical measure of brain activity, as well as a vital potential for diagnosing mental disorders and brain disorders. [30, 31]. The Electroencephalogram (EEG) recordings are another option for the distinction of tiredness and alertness states in freshly built cars will warn that drivers if any drowsiness indicator is identified. [24]. Also, the use of electroencephalography (EEG) is widely used to detect and study human stress, especially in the frontal lobe. [29]. The active frequency components present at each instant of time can be finding out by decomposing the EEG signals into multi-components [22]. where feature extraction and classification are done using some type of EEG (electroencephalogram) signal processing approach [25]. Brain signals are a collection of various basic flows. These large traffic ranges have been separated into various subgroups known as electroencephalogram (EEG) rhythms or traffic ranges. It reflects the entire traffic range of different mental or cognitive states in the brain. Theta, delta, alpha, beta, and gamma rhythms can be seen in brain waves depending on the brain's functioning condition. Any minor variations in the traffic patterns of this waves can aid in identifying neurological disorders. [3].

The EEG of a normal person differs from that of others. Low alpha band power has been observed And the lack of similarity in relation to the painful side before and during the episodes without aura compared to the partial phase, in accordance with the inconsistency of the alpha range, which was reported before the migraine episodes with the aura. [1]. Additionally, in migraineurs who have bouts of impaired consciousness and neurological deficit, frontal intermittent rhythmic delta activity (FIRDA) in the electroencephalogram (EEG) during and shortly after migraine attacks has been reported. This suggests dysfunction in the upper brainstem as well as the occipital and medial temporal lobes. [20].

The availability of neural signals in more detail around the activity of individual neurons, this enables the investigation of the axonal transmission and temporal regulation of brain communication. However, because electroencephalography (EEG) recordings provide a wide picture of brain activity, they are ideal for detecting the neurological diseases and studying brain dynamics in general. Fixed and non-linear EEG signals. As a result, analyzing electroencephalogram (EEG) signals may be problematic. Studies on neurological disease diagnosis, including some symptom extraction operations, are undertaken by applying signal processing algorithms to difficult-to-analyze electroencephalography (EEG) information. In addition to signal processing approaches, EEG signals can be easily analyzed using machine learning (ML) or deep learning (DL) methods. [6].

Migraine is characterized by a series of phases (pre-ictal, ictal, inter-ictal and post-ictal), Using electroencephalography in the state of rest, it was shown that migraine patients in the two stages between the onset and the onset, but not in the stages before and after the onset, show the strength and coherence of the electroencephalography less than HCs. [10]. Although electroencephalography (EEG) is one of the best brain imaging tools to detect rapidly changing brain activities, it has a major drawback, which is that the spatial resolution is low, which makes it difficult for researchers to accurately determine the location of activity in motor or sensory areas. or distinguishing between different regions. [8].

1.2. FMRI overview

The magnetic resonance imaging It is a non-invasive imaging technique to assess changes in blood oxygen level-dependent (BOLD) signals. This signal is an indirect measure of neuronal activity through the process of the neurovascular coupling. [4].

Although the temporal resolution of this approach is several times lower than that of EEG, the spatial resolution enables for accurate investigation of individual brain areas' activity. Given the very evident association between migraine and pain-related circuits, as well as the less clear relationship with emotion regulation, the fMRI allows researchers to explore these networks more directly. [16].

Method one of the most common approaches for studying brain activity in migraine sufferers is to apply a controlled painful stimulus to a region outside the head, such as the back of the hand, and then evaluate the evoked activity for the BOLD signal using fMRI. This has been accomplished using both heat catalysts and gaseous ammonia. In contrast to healthy people, the great majority of studies in migraineurs between attacks demonstrated increased BOLD activity in cortical and subcortical brain regions involved in processing nociceptive and nociceptive information. [15]. It also allows for the identification of the features that contribute most to the individual classification or prediction, which can offer fresh insight into differences between the two groups. This is because it explores the inherent multivariate nature of the high-dimensional neuroimaging data and is sensitive to fine spatial discriminative patterns. [33, 34]. Machine learning has been used to investigate a number of potentially sensitive and specific neuroimaging biomarkers in neurological and psychiatric disorders, which are anticipated to help with diagnosis and therapy. [35, 36, 37, 38]. With an accuracy of 83.33 to 91.4%, machine learning in conjunction with functional magnetic resonance imaging (fMRI) has been utilized in certain prior research to distinguish migraineurs from healthy controls (HCs). [39, 40]. Moreover, Previous studies predicted the success of acupuncture for treating migraines before treatment in individuals, leading to the development of a personalized medical strategy based on the prediction model. [39, 40].

The BOLD signal is an indirect measure of the neuronal activity and is subject to high levels of the noise. Additionally, FMRI studies do not reflect specific neuronal subpopulations (e.g., an increase in excitatory or inhibitory activity can lead to a higher BOLD signal), and the results are dependent on the specific statistical methods used. Despite these limitations, the FMRI studies can be informative about brain processes. [4].

FMRI has several distinct benefits. The first is that it has high spatial resolution in the millimeter and perhaps sub-millimeter range, and this allows for more precise spatial mapping of brain responses, and the second is that it can detect 3D activities deep within the brain. Electroencephalogram (EEG)-based approaches may have difficulty imaging activity at deep subcortical sites, while functional magnetic resonance imaging (fMRI), on the other hand, still has significant drawbacks. The insufficient temporal resolution of fMRI is its most obvious drawback. The EEG approach has better temporal resolution than fMRI. The ability of fMRI to resolve neural events is on the order of seconds, compared to the milliseconds of EEG [8].

2. Summary of Previous studies

The present review will summarize MRI and EEG studies on prediction, detection and classification of migraine.

2.1. Participants dataset

Because the migraine sufferers without aura experience headaches without warning, The beginning of the prepuerperal phase is the optimum moment to warn patients about an impending assault. Only EEG data collected during the interictal and preictal periods were used by **Zehong, Kuan-Lin and others in 2017** in **[12],** Forty patients with migraine without aura and 40 normal patients of the same age in a room with no lighting at the Taipei Veterans Hospital. Second Edition of the International Classification of Headache Disorders (ICHD-II) (26) diagnostic criterion was fulfilled by all recruited patients, and they all experienced the migraine frequency ranging from 1 to 6 days per month.

Healthy controls (HCs) who were matched for age and sex were chosen from among hospital staff members as well as their friends or family. Resting-state EEG signals from the frontal and occipital lobe regions were prospectively collected by **Firat, Fatma and Recep on May 28, 2023 [6],** the Electroencephalographic (EEG) signals were collected from the 21 HC groups (12 females,9 males, all aged 19-54 years, mean age 27.8 years) without headache and the 18 patients with interictal migraine (13 females/5 males, all aged 19-54 years). years (average age: 27.6).

The International Headache Society's criteria were used to choose the study's participants. EEG recording dataset used by **Kazemi and Katibeh in 18 August 2018 in [17],** Obtained from 24 children (8 males - 16 females) ages 8 to 18 years diagnosed with the migraine without aura, using the ICHD3 criteria for the headache disorders, and 19 healthy controls (7 males - 12 females) with migraine or another type. A 10-minute posterior EEG recording is conducted with the eyes closed, in a quiet room with as little noise as possible.

In the study conducted by Hao Yang, Junran Zhang, and others in 2018 **[11]**, It included 21 patients with migraine without aura, 15 patients with migraine with aura, and 28 healthy subjects they were between the ages of 18 and 50 when their brain scanned at West China Hospital's Huaxi MR Research Center. Patients were free of attacks for at least 72 hours prior to and 48 hours following the brain MRI. Subjects were advised to close their eyes and rest without thinking or sleeping.

The dataset that used by **ALEX FRID et al** In September 2019 in **[2],** It was gathered from 53 female migraine patients who participated in this study. All the migraine patients met the International Classification of Headache Disorders (ICHD) migraine diagnostic criteria (trial version 20131). Inclusion criteria included <= 15 migraine attacks per month, ages 18 to 75 years, no pain or neurological condition, no use of preventative drugs in the past 3 months, and a laboratory session completed 48 hours after the last migraine attack.

In 2023, Katarina Mitrović et al. **[13]** conducted a study involving 78 subjects, consisting of 46 patients 22 with Migraine with Aura Simple (MwA-S) and 24 with complex (MwA-C) as well as 32 healthy controls. The study aimed to train an algorithm for magnetic resonance imaging (MRI) using a comprehensive set of 340 different features, including cortical thickness, cortical surface area, cortical volume, cortical mean Gaussian curvature, and cortical folding index.

The exclusion standards listed below were applied:

(1) the existence of other headache kinds, with the exception of tension headaches and sporadic migraines without aura.

(2) any further neurological, cardiovascular, or metabolic condition found during a physical examination or by reviewing the medical history.

(3) mentioned having claustrophobia or being unable to conduct an MRI, and

(4) Significant abnormalities in the MRI scans, such as tumors or lesions.

2.2 Predictive Model for Migraine Detection and Classification: A Comprehensive Approach

First, the features are extracted to benefit from them later after improving them and applying classification algorithms to them to build models that can diagnose the disease and classify it among different groups of individuals.

Where the Welch's method and Yule-Walker Autoregressive (AR) method of feature extraction were utilized by (Kazemi, et al in 2018) and (Alix Frid, et al in 2019) to obtain power spectra, The ReliefF20 algorithm was used to rate each feature and then choose the top 10 features (i.e., the best subset) in situations when the number of features is high relative to the amount of the data (Alix Frid et al., 2019). Here, twin goals were sought after: first, characteristics that could effectively distinguish (i.e., classify) across groups; second, the ability to pinpoint the precise location of the genesis of variations between the patients with and without aura at the brain level.

Following that, (Kazemi, et al., 2018) apply a binary genetic algorithm to acquire optimum features for classification and accuracy computation. Analysis of multiscale inherent fuzzy entropy, which employs fuzzy membership function and empirical mode decomposition (EMD) to enhance the estimation of each coarse-grained time series for the various time scales from 1 to 20 of the EEG signal, was used by Zehong et al. (2017) to compare the brain complexity between the migraine stages.

The MD and HC groups' 1-D EEG recordings were pre-processed by (Fırat, et al in 2023) to remove noise. Then, using "CWT and STFT" TF transformation techniques, Noise-free EEG signals were converted into scalogram spectral images in the time-frequency domain. The classifier models dictated the necessary input sizes for the images that were obtained using TF modification procedures and utilized as data in the classification stage.

Finally, A binary classification model was created utilizing machine learning algorithms such as linear discriminant analysis (LDA), (kNN) k-nearest neighbors classifier, Bayesian classifier, and support vector machine (SVM) by (Zehong, et al in 2017) and (Katarina Mitrović, et al in 2023) while (Kazemi, et al in 2018) used only two methods for data classification: the support vector machines (SVM) and the linear discriminant analysis (LDA) by MATLAB functions fitcsvm and fitcdiscr, respectively. As for (Alix Frid, et al in 2019), they used the SVM algorithm only. The classification of (Fırat, et al. 2023) it is implemented by applying histogram and spectrum images of the MD and HC ensembles to some the CNN architectures (AlexNet, ResNet50, Squeeze Net) and to the DCNN model that they created for their selves. According to Hao Yang et al. (2018), deep learning techniques were combined with three functional measures based on Rs-fMRI data (amplitude of low-frequency fluctuations, regional homogeneity, and strength of the regional functional correlation) to distinguish between the migraineurs and the healthy controls as well as between the two migraine subtypes and healthy controls.

2.3 Devices used to record migraine data

(Zehong et al, 2017) captured the EEG waves. employed the Mindo-4S (Hsinchu, Taiwan) (29), a wearable EEG gadget that is wireless and has four dry electrodes, a small amplifier, and a bandage that is modest in weight. At 500 Hz sample rate, EEG signals were recorded at sites Fpz, O1, Oz, and O2. In accordance with the Expanded International System 10-20, electrodes were placed., with two additional channels, A1 and A2, serving as reference channels.

Raw EEG data were captured at 250 Hz and filtered using 1 Hz and 30 Hz high-pass finite impulse response filters. All the classification algorithms were built with either PRTools (35) or LIBSVM (35). (Fırat et.al, 2023) obtained EEG recordings using the BioSemi Active Two system. The EEG signal has a sampling frequency of 512 Hz and were recorded from 128 channels **[18].** Electroencephalogram (EEG) recordings were made by providing auditory and visual stimuli to individuals based on their resting states. In the visual condition, the grid pattern altered with contrast modulation at either 4 or 6 Hz. For stimulation, auditory tones in the range of 4-6 Hz were employed. People were instructed to concentrate on a fixed plus sign that showed on the screen while they were at rest. **[19].**

(Kazemi et al., 2018) collected EEG data using an EEG device with a sampling rate of 256 Hz and 19 electrodes in accordance with the conventional (10-20) system. Preprocessing was done with the band-pass filters from 0.5 to 30 Hz to reduce noise over 30 Hz, such as muscular contractions and the electrostimulation at 50 Hz. All analyses were performed using (MATLAB 2014).

Hao Yang et al. (2018) utilized the successful Inception module-based CNN, developed by Szegedy et al. [18], for item recognition and classification, it has three convolutional layers, two pooling layers, and two fully linked layers. The major strategies utilized to improve the accuracy of the CNN design were to increase the layer size and network depth). (Alix Frid et al., 2019) recorded electroencephalograms (EEGs) using three different systems: (i) a 32-channels QuickAmp40 for Brain Products (N = 35), (ii) a 64-channels BioSemi (N = 10), and (iii) a 64-channels ActiCHamp Brain Vision (n = 8). Because of the intrinsic disparities in the EEG cap electrode placements between this systems, data from all 26 overlapping channels were evaluated.

Katarina Mitrović et al. (2023) used a 3T scanner (MAGNETOM Skyra, Siemens, Erlangen, Germany) for their MRI study. The free surfer analysis (version 6.0) was carried out on an HP DL850 server (Intel Xeon 3.2 MHz, eight cores, and 16 GB RAM) with a recon-all script, which combined 3D T1 and the FLAIR images for cortical reconstruction. Automatic segmentation of brain structures. The average run time (with collimation enabled) was six hours. Feature selection and machine learning models were developed using Python (version 3.8) and the Jupyter Notebook environment. The hardware arrangement used in this investigation featured an NVIDIA GeForce (GTX 1650 Ti GPU), an AMD Ryzen (54600H 3.00 GHz CPU), and (8 GB of RAM).

3. Results of previous studies

The previous literature reviewed shows differences in the neural mechanisms and methods used for diagnosing migraine and the results were as follows:

The study by (Zehong et.al, 2017) suggests that There increase in the EEG entropy of the Fpz site in the frontal lobe region of migraine patients in the preictal phase compared to the ictal phase, where increased complexity may indicate improved systemic function. When used combined, normalization of brain activity may be a predictor of oncoming migraine attacks in some MO patients. The SVM-RBF achieved the best accuracy (76+4%), surpassing LDA, MLP, and the Bayesian classifier ($P < 0.05$).

According to the resting state, the most successful findings by (Fırat et al, 2023) were obtained by employing the CWT approach with the AlexNet classifier (Acc: 99.74%, Sens: 99.9%, Spec: 99.52%). In terms of auditory stimuli, the DCNN model proposed in the CWT technique achieved the greatest results (acc: 99.44%, sensitivity: 99.04%, specificity: 99.74%). Under the visual stimuli condition, the CWT method and the DCNN model performed the best (acc: 98.96%, sensitivity: 98.24%, specificity: 99.5%).

data analysis adopting Welch's method as the feature extraction method by (Kazemi et.al, 2018) using the SVM classification results in an accuracy of 93%, the Welch method produces better diagnostic accuracy values and outperforms the Yule-Walker AR model, as does SVM classification over LDA.

Data from (Hao Yang et al., 2018) demonstrates that the Inception module-based CNN beats the AlexNet-based CNN. The highest detection rate was 99.25% when using an Inception module-based CNN to distinguish between HC and migraine groups and 96.13% for MWoA versus MWA.

Most of the information regarding the differences between MWA and MWoA is in the study of (Alix Frid et.al, 2019) is concentrated in the theta band. The theta bar contains important information (average classification rate 84.62% and area under the curve 0.88, i.e. "good test") regarding differences between the migraine types.

The LDA algorithm produced the best results in research by Katarina Mitrović et al. (2023). The maximum accuracy was attained for MwA classification at 97%, while MwA subset prediction achieved 98% accuracy. When it comes to subgroup classification, the majority of algorithms (with the exception of SVM) performed better.

The result outcome for all studies that referred to used brain signal in migraine it described it table (1), with describing main advantage and disadvantage for each point.

Table (1): "Overview of migraine diagnosis research"

Ref.	N. participant	Method	Filter used	strength point	Weaknesses
[12]	40 patients, including 10 males and 30 females from The HC group recruited 40 individuals, including 32 males and 32 females.	EEG	The raw EEG signals were filtered through (1Hz high-pass) and (30 Hz low-pass) finite impulse response filters then analyzed using EEGLAB and entropy analysis	Through the complexity of electroencephalography (EEG). The transitional phase of a migraine is captured and provided an opportunity to create a classifier to recognize the patient's current stage.	The migraine stages of the interest were limited to ictal and preictal states. The quantity of data is modest and the number of electrodes is small
[6]	18 Patients with migraine during interictal periods (5 males/ 13 females), 21 HC groups (12 females/9 males)	EEG	Noise in EEG signals recorded for visual and auditory signals The obtained stimulus and resting state were multichannel cleaned using A Finite Impulse Response (FIR) filter with frequency 0.5-40 Hz.	This study is pretty detailed. and this study is the first in the literature to do so.	Research on the diagnosis of migraines and the application of EEG signals in deep learning models is quite unusual. As a result, there were few research with which we could compare the findings of this investigation.
[17]	24 children (16 females and 8 males) aged 8 18 years old and 19 healthy	EEG	filtering bands between 0.5 and 30 Hz Eliminate all noise higher than 30 Hz, such as the	Application of the genetic algorithms to find the optimal combination of (features and electrodes) to maximize	This study focuses on pediatric EEG migraine classification

	people (12 females and 7 males).		contraction of muscles and electroporation at 50 Hz. Every analysis Created using MATLAB 2014b	performance. Precision is key. This study differs from past efforts in EEG migraine classification.	
[11]	15 migraineurs with aura ,21 migraine patients without aura and 28 healthy controls.	MRI	The time series for each voxel underwent the band pass filtering [0.01-0.08 Hz] to lessen the impact of (low-frequency) drifts and the (high-frequency) physiological noise.	Besides identifying HC and migraine, this technique was also able to differentiate between the MWoA (Migraine Without Aura) and MWA (Migraine With Aura). And It will be useful in clinical diagnosis	The data set was already small and there was still no definitive result Regarding utilize the picture in the deep learning framework after feature mapping or original Rs-fMRI generates better results.
[2]	53 episodic female migraine participants participated in this study.	EEG	0.15–100 Hz band pass filter	This work correctly predicts MWoA and MWA, and uses machine learning on EEG signals to automatically identify between proficient and dyslexic readers.	Small number of participants, and this data were collected using 3 different recording systems therefore, the signal-to-noise ratio of these data is quite low.
[13]	78 participants (32 HCs and	MRI	Feature selection and the machine	This work's primary contribution was the development of a	Patients with migraine without aura

	46 MwA). (MwA = 72% females; HCs around 70% females)		learning models were created using Python 3.8 and the Jupyter Notebook environment. The Scikit-Learn package package provides machine learning functions, whereas the Pandas library handles data processing and analysis.	machine learning method that can accurately classify MwA vs. HC and MwA-C vs. MwA-S subgroups. According to this study, the LDA algorithm has the greatest potential for classification tasks, which enables it to take on the challenge posed by existing MwA therapies.	were not included

4. Discussion and Conclusion

This paper discusses two brain imaging methods and their limitations in detecting migraine and distinguishing between its types, which are EEG and FMRI, and given the limitations imposed on each technique, The EEG technique is the best for migraine, because the resonance imaging has loud sounds that may increase the severity of the headache or may cause a new attack of migraine due to the sensitivity of some people to noise.

It also increases the level of tension and shortness of breath due to the narrow space. Therefore, it is not suitable for some migraine patients and asthma patients, as well as for individuals who suffer from claustrophobia and the narrow. In addition to the reduced requirements for EEG devices and its low cost compared to neuroimaging method.

Electroencephalogram (EEG) recordings are useful in identifying dysfunctional neural dynamics in diseases such as Alzheimer's disease, epilepsy, and migraine, so it is very popular in the field of neurological diagnosis.

EEG also has the advantage of assessing the functional state of the brain with high temporal accuracy, since migraine goes through several stages before the seizure, during the seizure, between the seizures, and after them, the time factor is very important. Therefore, by working on these signals we can predict a seizure before it occurs to reduce some symptoms as much as possible to improve the patient’s health condition, and this in turn benefits the individual and society.

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