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Research Article

Frequency of Different Types of Artifacts in Electroencephalography of the Brain of Hospitalized and Outpatient Patients Referred to the Clinics of Al-Zahra Hospital and Khorshid Hospital in Isfahan

Noushin Mehrbod, MD*

Neurologist, Isfahan university of medical sciences, Iran.

***Corresponding Author:** Noushin Mehrbod, MD, Neurologist, Isfahan university of medical sciences, Iran.*

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Abstract

Background: Artifact is a common error in patient's electroencephalogram that if not addressed, it can lead to reduced quality and ultimately misdiagnosis. The aim of this study was to determine the frequency of different types of artifacts in electroencephalography of the brain of hospitalized and outpatient patients referred to the clinics of Al-Zahra Hospital and Khorshid Hospital in Isfahan.

Methods: In this cross-sectional study that was performed in Al-Zahra and Noor hospitals in Isfahan in 1399, 256 patients were studied by electroencephalography and examined for their electroencephalography, the presence of physiological and non-physiological artifacts and the source of artifacts in them.

Results: Out of 256 patients studied, in 237 cases (92.6%) the artifacts were physiological and 19 (7.4%) were non-physiological. The type of physiological artifacts included 217 cases (91.6%) ocular, 1 case (0.4%) cardiac, 5 cases (2.1%) sweating and 14 cases (5.9%) motor. Among non-physiological artifacts, 11 (57.9%) were electrode and 8 (42.1%) were external artifacts. There was no significant difference in the type of artifacts performed according to the age and sex of the patients.

Conclusion: The findings of the present study show that the presence of artifacts in patient's electroencephalogram is very common, and among them, physiological ocular artifacts and non-physiological electrode artifacts are the most common errors in patients' electroencephalogram and therefore it is necessary to Investigate the possibility of different types of artifacts and take the necessary strategies to reduce them.

***Keywords:** EEG, Artifact, Electroencephalography*

Introduction

EEG is one of the most important methods for evaluating and diagnosing neurological patients. Despite scientific advances in the diagnosis and treatment of neurological diseases, this method still retains its importance and validity in various fields, especially in patients with seizures and a number of other diseases of the nervous system [1]. Another advantage of this method is its ease of use, which is more accessible and cheaper than many other diagnostic methods [1-2].

Artifacts are electrical potentials that do not originate in the brain. Different artifacts can cause a decrease in the quality of the EEG and sometimes make it difficult or wrong to diagnose, while some reflect natural physiological processes that are essential for analysis [3]. Artifacts have different origins, so that some artifacts that originate from the device or the environment itself, and others, including physiological artifacts, come from things like heart rate, eye movements, muscle contraction, and so on.

Recognizing the difference between the potentials generated in the brain and the activity that does not originate from the brain model is the basis for artifact recognition [1, 4]. Proper closing of electrodes, correct positioning of the patient, observance of electrical insulation standards in the room, patient cooperation during the process and observance of immobility are the main factors that help to record brain waves correctly and prevent diagnostic error [5].

The frequency of different types of artifacts varies depending on the different centers and the device and techniques used. In the study of Vergalt et al., It was found that muscle artifacts infect 97% of ictal bands and interfere with the interpretation of 76% of brain bands, especially in extratemporal seizures [6]. This data is not comparable or generalizable between different centers.

Various studies have been performed to reduce artifacts in the EEG. Improving brain tape recording techniques, computer methods for removing artifacts and the use of various filters are ways to improve the quality of brain wave recording [3, 7-8]. In the intervention of Lee One et al., An automatic system was used to remove the artifacts, which had a sensitivity of 82.4% and a specificity of 83.3%, and largely eliminated the artifacts. The sensitivity and specificity of this method is to a large extent similar to the removal of an artifact by a trained operator [9]. In another study, botulinum toxin injection was used to reduce myogenic artifacts, which significantly reduced myogenic artifacts [10]. Removal of muscle artifacts has been shown to increase the sensitivity of seizure localization from 62% to 81%, and its best effect is in ictal bands with moderate to severe muscle artifacts. Removing the artifact causes earlier detection of ichthalmic changes and detection of items hidden in the artifact [6]. On the other hand, some studies have shown that the use of some methods and computer programs to remove artifacts has low validity [11].

Regardless of all available methods for removing artifacts, compliance with the necessary standards by the performer is essential to maintain the quality and diagnostic value of the electroencephalogram. It is necessary to train the relevant operator and observe the necessary details in performing the brain scan from the beginning to the end [1]. Despite advances in digital, identifying, recognizing, and resolving artifacts is essential to correctly interpreting brain scans. On the other hand, it is necessary to make an initial assessment of the current situation in each ECG recording center. Awareness of the extent of these errors can have a positive effect on the diagnosis and care of patients to improve and improve the quality of the electroencephalography process. The aim of this study was to investigate and report the frequency of various artifacts in the electroencephalogram of patients referred to the electroencephalogram clinic of Al-Zahra Hospital in order to use it to improve the quality of brainstem imaging.

Material and Methods

This study is a cross-sectional study that was conducted during 2020-2021 in Al-Zahra and Noor hospitals in Isfahan. The target population of the study was patients referred to the electroencephalogram clinic of the mentioned hospitals.

Inclusion criteria included the patient undergoing electroencephalography in Al-Zahra and Noor hospitals, the availability of electroencephalogram and patient demographic information, and the presence of at least one artifact in the electroencephalogram. Also, the lack of sufficient information in the file and the impossibility of correcting the defects, as well as patients with illegible and invalid electroencephalograms were excluded from the study.

All of the patient's brain scans were examined by a neurologist for a variety of artifacts. Also, demographic information and medical history of patients, the main complaint of the patient, the presence or absence of seizure history, history of seizures and the duration of the disease were reviewed and recorded.

The data were finally entered into SPSS software version 26 and analyzed by Chi-square, Fisher's exact test, T-test and one-way analysis of variance.

Results

In this study, 256 patients with electroencephalography who had artifacts in the brain were studied. The mean age of patients was 46.13 ± 22.6 (range 5-93) years. Figure 1 shows the frequency percentage of patient's age group.

139 patients (54.3%) were male and 117 patients (45.7%) were female. The mean age of men and women was 47 ± 22.2 and 45.1 ± 23 years, respectively, and no significant differences were observed between the sexes (P = 0.52). According to the results, the most common type of artifact observed in the studied patients was ocular artifact with a frequency of 202 cases (78.9%), electrode with a frequency of 152 cases (59.4%), and peripheral movement with a frequency of 109 cases (42.6%). (Figure 2).

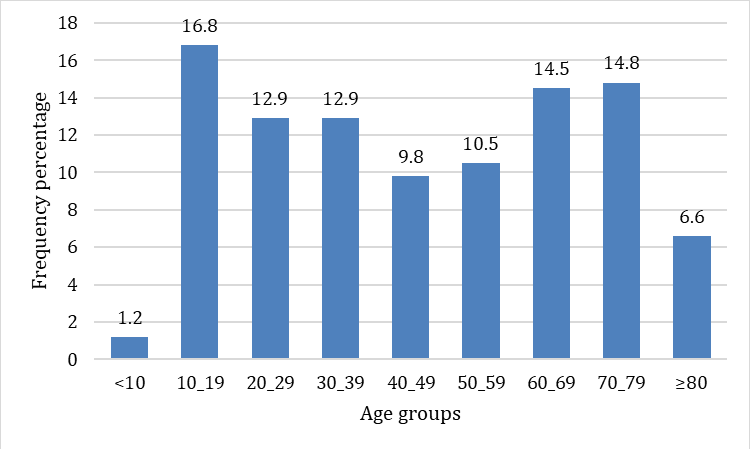

Figure 1: *Frequency of age group of patients studied.*

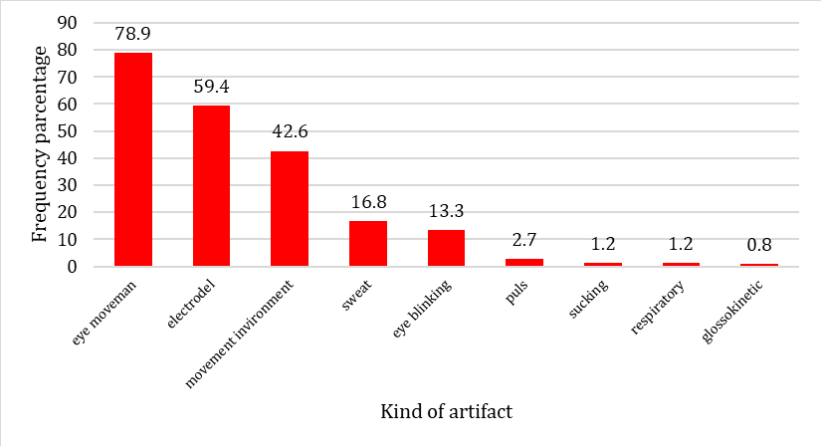

Figure 2: *Frequency Percentage of artifact type observed in patients's electroencephalogram.*

Among 256 studied patients, in 237 cases (92.6%) the artifacts were physiological and 19 (7.4%) were non-physiological. The type of physiological artifacts included 217 cases (91.6%) ocular, 1 case (0.4%) cardiac, 5 cases (2.1%) sweating and 14 cases (5.9%) motor. Among non-physiological artifacts, 11 (57.9%) were electrode and 8 (42.1%) were external artifacts. (Figure 3)

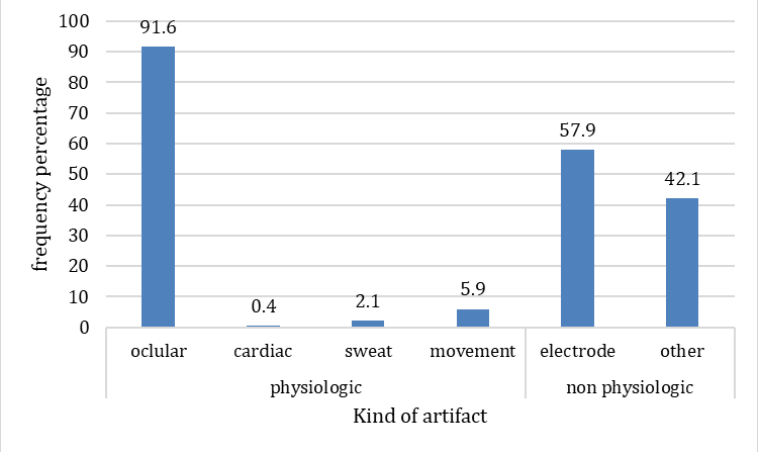

Table 3: *Frequency Percentage of physiological and non-physiological artifacts.*

According to Table 1, the mean age of patients in terms of physiological and non-physiological artifacts was not significantly different (P = 0.85) and although the frequency of physiological artifacts in men (55.3%) was higher than women (42.1%), but the difference between the sexes Was not significant (0.27). Comparison of age and sex distribution of patients in both physiological and non-physiological artifacts also showed that patients with motor artifacts had the highest mean age (56.1 ±19.8 years) and patients with sweating artifacts had the lowest mean age (38.2 ±27.1 years). However, according to one-way analysis of variance, the mean age of patients according to the type of physiological artifacts was not significantly different (P = 0.32). In terms of sex distribution, the frequency of physiological artifacts in men and women was not significantly different (P = 0.69).

Regarding non-physiological artifacts, patients with electrode artifacts had a lower mean age than artifacts from external sources, but the difference between the two groups was not significant (P = 0.25). The frequency of electrode artifacts was 35.7% in men and 72.7% in women, but the difference between the sexes was not significant (P = 0.13).

Table 1: Frequency distribution of artifact types by age and sex.

Variables		Age		Sex		
		Mean (+SD)	P	male	female	P
Kind of artifact	Physiologic	46.2 ±22.5	0.85	131(55.3)	8(42.1)	0.27
	Non physiologic	45.2 ± 24.1		106(44.7)	11(57.9)	
Physiologic Artifact	Ocular	25.7 ± 22.5	0.32	121(92.4)	96(90.6)	0.69
	Cardial	51		1(0.8)	0(0)	
	Sweat	38.2 ± 27.1		2(1.5)	3(2.8)	
	movement	56.1 ± 19.8		7(5.3)	7(6.6)	
Non physiologic	Electrode	39.6 ± 22.5	0.25	3(35.7)	8(72.7)	0.13
	Extrinsic sources	52.8 ± 25.7		5(62.5)	3(27.3)	

Discussion

Observing different artifacts in the electroencephalogram is a serious challenge for internal neurologists, so that the presence of different artifacts, both physiological and non-physiological, has a serious impact on the quality of the electroencephalogram of patients and may cause errors in diagnosis. Therefore, in order to improve the quality of patients' electroencephalogram, it has been tried to prevent this challenge in different ways, and since there are different sources for artifacts in the electroencephalogram, this study aims to investigate the frequency of artifacts in brain electroencephalography. Inpatients and outpatients referred to the clinics of Al-Zahra Hospital and Khorshid Hospital in Isfahan were performed.

The findings of the present study showed that physiological artifacts constitute more than 90% of the X-ray artifacts of patients and among the physiological types, ocular artifacts including eye movements and blinking are the most common physiological artifacts in the studied patients. . Findings from several studies have shown that EEG artifacts have always been problematic in patients' EEGs and have had a high prevalence, so that in an old study conducted in 1974 by Corby et al. The most common type of artifact has been reported to be electrode (12). In another study by Ahmed et al.

The findings of our study showed that the most common artifact observed in patients undergoing electroencephalography is ocular artifact. In this regard, the results of a study conducted by Rashed et al. In 2013 reported ocular artifacts as the most common EEG artifacts, the findings of which are consistent with the results of our study (14). In the study of Tran et al., Ocular artifacts were the most common artifacts in patients's electroencephalogram (15).

The results of the study showed that the type of artifacts created in patients's electroencephalogram did not differ significantly according to the age and sex of patients, although the incidence of some artifacts, including physiological artifacts, may be different in different age and sex groups (16 However, controlling them in different ways can improve the quality of patients' brain scans and ultimately reduce the error in diagnosing the disease.

Conclusion

The findings of the present study show that the presence of artifacts in patients's electroencephalogram is very common, and among them, physiological ocular artifacts and non-physiological electrode artifacts are the most common errors in patient's electroencephalogram, and therefore it is necessary to Taking a brain scan examines the possibility of various artifacts and the necessary strategies to reduce them. At the same time, due to the limitations of this study, including the small sample size and the lack of a control group, it is suggested that more studies be conducted in this field.

Study Limitation

The study faced limitations such as small sample size, so it is suggested that more studies be done in this field.

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The present article was approved and implemented in 2021 in the field of research of Isfahan Medical School.

Author's Contribution

MrN: Study idea, study design, interpretation and contribution in writing the paper.

NM: contributed in data collection and data analysis and preparation of paper.

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