

Effects of Muslims praying (Salat) on EEG gamma activity



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ABSTRACT

This study investigates the difference of mean gamma EEG power between actual and mimic *Salat* practices in twenty healthy Muslim subjects. In the actual *Salat* practice, the participants were asked to recite and performing the physical steps in all four stages of *Salat*; whereas in the mimic *Salat* practice, they were instructed to perform only the physical steps without recitation. The gamma power during actual *Salat* was statistically higher than during mimic *Salat* in the frontal and parietal regions in all stages. In the actual *Salat* practice, the left hemisphere exhibited significantly higher mean gamma power in all cerebral regions and all stages, except the central-parietal region in the sitting position, and the frontal area in the bowing position. Increased gamma power during *Salat*, possibly related to an increase in cognitive and attentional processing, supports the concept of *Salat* as a focus attention meditation.

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1. Introduction

Islam has been known as one of the major religions among nations. There are 1.2 billion Muslims all over the world [1]. *Salat* is one special way to worship God among Muslims which can improve physical and mental state of prayers in terms of alertness, concentration, and recreation [2]. *Salat* is composed of different body postures and recitation of different meaningful “mantra” during each posture. This practice is obligatory for Muslims to perform prayers five times a day [3]. Concentrating on practice, repeating certain phrases and remains focused on worship of GOD may introduce *Salat* as a meditation practice.

Meditation is a self-regulatory practice to improve mental and emotional control [4,5]. Meditation practices are classified into three main categories: open monitoring (OM), focused attention (FA), and transcendental meditations (TM) [6–9].

Focused attention (FA) is a category of meditation based on EEG pattern which helps wandered mind to focus on a given object (like visualization of an image, recitation of a mantra or perception of one's own breathing) [10]. FA meditation is identified by induction of gamma power during meditation [11]. Gamma band frequency is mostly used for investigation of cognitive and attentional

processing, learning, and working memory [7,12–15]. Attention and concentration are two very important cognitive abilities characteristic of human beings. They are not the same, although the two terms are used interchangeably. According to Park and Ingles (2001) [16], attention is defined as the “voluntary control over more automatic brain systems to be able to select and manipulate sensory and stored information briefly or for long periods of time”. While the concentration is referred to the act of isolating one's attention on a specific object, task, or aspect of consciousness while ignoring other things. Controlling one's attention is the ability that we call as concentration. We cannot concentrate on an object or an activity unless we pay selective attention to it [16].

Study of three-dimensional distribution of gamma band generators using low resolution electromagnetic tomography (LOR-ETA) proved existence of different gamma gravity centers in different meditation methods: during mantra verbalization gamma power increased in the left central regions while during visualization meditation it increased in the right posterior areas [17]. According to findings of [18] on Buddha practice as a FA meditation, long term Buddha meditators demonstrates higher gamma power over frontal-parietal regions as compared to a control group with no previous meditative experience [18].

Many studies have investigated the psychophysiological effects of various meditation methods on human brain. Meditation studies based on EEG analysis have been conducted for about 50 years [19], yet the effects of *Salat* on mental state of prayers remain unclear.

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The present study tries to investigate the effects of *Salat* on Muslim's brain activity through analyzing gamma power during *Salat* praying.

2. Materials and methods

2.1. Participants

For this study twenty Muslims subjects (male) aged 26 ± 5 were recruited. Subjects in this study were familiar completely with performing *Salat* (they had continuously performed *Salat* for 14 ± 5 years). Before collecting data all the procedure and significant of this research were explained for them. The consent form was obtained from each of them prior to enrollment to the study. They did not have any psychological and neurological disorders.

2.2. Description of *Salat* postures

Prayers consequently repeat four main body postures (Fig. 1) during their praying and each posture consists of individual mantra. There are certain body conditions required for each posture:

- Standing: An upright standing position with approximate duration 30–60 s.
- Bowing: This posture is followed by a 90-degree bow, with hands touching the knees, and pressing down so that the vertebral is placed column horizontal. The bowing action takes about 5–10 s.
- Prostrating: In this position which lasts about 5–10 s the prayer's forehead should come in contact with the ground. This position is as follows: a) the hands are kept away from the sides of the body and palms touches the ground, b) elbows are should be raised off the floor, c) forehead and face are placed between both palms, and d) fingers should be set close together.
- Sitting: A resting step on the floor. Left foot is placed beneath the right foot; while the right foot is positioned upright. Sitting step takes about 30–60 s.

2.3. Data acquisition

Data collection was done at a silent and comfortable room and temperature was adjusted between 20 and 22° of Celsius. EEG data of the subjects were recorded through 8 channels (FP1, FP2, F3, F4, C3, C4, P3 and P4) using MP150 EEG acquisition system (BIOPAC systems Inc., California, USA) according to the International 10–20 system of electrode placement, with sampling frequency of 250 Hz. Channels were online referenced to linked ear lobe electrode and their impedances were kept under 10 k ohm. In this study these channels were selected to cover main brain regions interrelated to

the executive attentional network and the orienting attentional network (dorsolateral prefrontal cortex, superior frontal sulcus and intra-parietal sulcus respectively) [8,9].

2.4. Experimental procedure

For this study, The EEG data was collected within four sessions. In the first session subjects were asked to sit on the comfortable chair placed into a silent position while their EEG was being recorded as an initial EEG baseline for three minutes. In first and third minute, subjects were asked to keep their eyes open and in second minute they were asked to keep their eyes close. In the second session subjects performed actual *Salat* practice while they have been asked to do praying as usual like other days praying. Actual *Salat* practice is praying with concentration and recitation of all phrases. In the third session subjects were instructed to perform the mimic *Salat* which they just performed body movements (Fig. 1) without recitation of phrases and concentration during their movements. During the fourth session, subjects were asked to be relaxed and remained calm while their EEG was recorded as a post baseline EEG. In this study second and third session (during *Salat*) were considered to investigate the alterations of gamma power during different postures of performing *Salat* and demonstrating how concentration and verbalization can initiate these changes.

2.5. Data analysis

In this study for reducing muscular artifacts, static positions (standing, bowing, sitting, and prostrating) in actual and mimic performing of *Salat* were extracted from the data, while the signal in between movements were excluded. For each electrode 10-s of standing posture, 5-s of bowing posture, 10-s of sitting, and 5-s of prostrating posture were extracted from datasets. Muscular and ocular artifacts were manually removed from the EEG data. Signals were filtered within 1.00–100 Hz by band-pass IIR (Butterworth) filter. For removing current line noise, a digital notch filter was also applied to the signals at 50 Hz. For considering gamma frequencies (25–60 Hz) power, Welch's method (Hanning windowing function, 0.5 Hz resolution) was then applied in 1s epochs for calculation of power spectral density (PSD) to derive the mean EEG gamma power (unit: $\mu V^2/Hz$). All the signal processing steps were carried out by using Acknowledge® 4 Software (BIOPAC MP150 System).

2.6. Statistical analysis

Statistical analysis was performed by SPSS (version 19.0). Tests of normality were performed on EEG measures. Paired T-test was used to study how the mean gamma power of each channel in actual postures differs from its equivalent in mimic postures. Paired T-test was also applied to evaluate difference of gamma power in the left and right hemispheres during actual *Salat* for each posture. For each test, the statistical significance was set to $P < 0.05$.

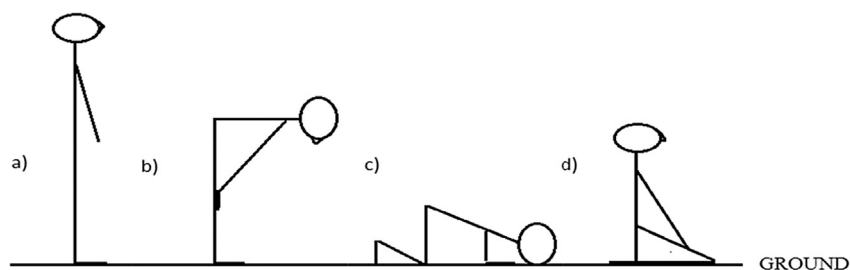


Fig. 1. Posture of prayers body during performing *Salat*; a) Standing b) Bowing. c) Prostrating, and d) Sitting.

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