The influence of Istighfar Dhikr on brain wave activity: An EEG-based study on anxiety management

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Abstract In the domain of leadership, individuals are not immune to the psychological ramifications of their roles, with anxiety being a notable byproduct of cerebral processes. Within the Islamic faith, the practice of istighfar, or seeking forgiveness, is promulgated as a remedial technique to mitigate such anxieties. To evaluate the impact of istighfar on cerebral functions quantitatively and impartially, this investigation employed electroencephalography (EEG) to monitor neural activity. Engaging 24 young adults, evenly distributed across genders, this study meticulously recorded neural oscillations amidst induced stress and subsequent istighfar invocation. Advanced analytical methods, including power spectral density and logistic binary regression, were applied to discern the influence of istighfar on neural wave patterns. The results illuminated a gender-based divergence in neural dominance post istighfar: males exhibited alpha wave activity, whereas females showed a pronounced shift in beta wave activity. The implications of this study are threefold: first, it establishes EEG as a reliable instrument for the objective measurement of neural activity alterations in anxious states; second, it corroborates the efficacy of istighfar in modulating neural wave dominance, thereby contributing to anxiety reduction; and third, it unveils gender-specific neural response patterns to istighfar. This inquiry not only augments the corpus of knowledge regarding the interplay of spirituality and neurology but also endorses istighfar as a potentially valuable intervention for anxiety management, thus bridging the gap between contemplative traditions and contemporary scientific validation.

Keywords: anxiety, Istghfar Dhikr, brain, EEG, leadership

1. Introduction

Assuming leadership roles invariably subjects individuals to an array of complex tasks and decisions. The onus of strategizing decisions (Surani et al., 2019), swiftly addressing and resolving issues (McKibben, 2017) and devising meticulous work plans (Spallina, 2004) aligned with the overarching goals of the organization constitute a mere fraction of their extensive duties. Such an assortment of scenarios can precipitate stress (McKeirnan et al., 2022), manifesting as psychological and mental strain. This stress, often culminating in anxiety (Yang et al., 2023), is an occupational hazard for leaders, who must navigate through these challenges while maintaining the equilibrium of their mental state and the efficacy of their leadership.

Anxiety manifests as a psychiatric affliction, often presenting with pervasive unease, concern, and trepidation that can disrupt routine functioning and adversely affect immune system efficacy (Dhabhar, 2014). Neurotic vulnerability (He et al., 2021) is characterized by a sense of insecurity and developmental immaturity, culminating in a compromised capacity to navigate life's exigencies, obstacles, and the inherent stresses of everyday existence.

In the Islamic tradition, faithful people are continually advised to adopt istighfar (Uthman, 2023)—the act of seeking forgiveness—as a key method for alleviating anxiety. Engaging in dhikr, the remembrance of the divine, is advocated as a means to tranquility, with istighfar dhikr being a specific recitation known for its ability to ease hardship, sorrow, and life's inherent anxieties, thus fostering serene existence. The Prophet Muhammad SAW said, "Whoever frequently seeks forgiveness (istighfar), Allah will turn all his difficulties into joy, every hardship into an opening for him, and Allah will provide him with sustenance from sources he never anticipated." (HR. Abu Dawud, Ibn Majah, and Hakim).

The influence of istighfar dhikrs, particularly on adolescents, has been demonstrated to significantly improve anxiety (Tasyakuranti et al., 2022). However, the issue lies in the empirical evidence or claims that istighfar can calm the human heart, which is suspected to be subjective and potentially biased. Therefore, there is a need for validation through technological
approaches that can minimize potential subjectivity and bias by directly analyzing the phenomena occurring within the human brain.

Encased within the cranium, the brain operates as the command center of the central nervous system (Zeng et al., 2022), orchestrating a myriad of vital biological, physical, and sociological operations across the human body. Comprising millions of intricately interconnected neurons (Herculano-Houzel, 2009), this compact yet profoundly complex organ facilitates communication through the transmission of electrical impulses (Lovinger, 2008). These impulses, which manifest as discernible brain waves (Yasui, 2009), are essentially the propagation of action potentials within specific cerebral regions (Khodagholy et al., 2015) and are indicative of the temporal activities of neuronal assemblies. The genesis of these waves lies in the dynamic neuronal activities that serve as conduits for both sensory perception (Brockmeier et al., 2012) and motor command transmission (Kim et al., 2013). Brain waves emerge due to variances in ionic concentrations within the intracellular and extracellular environments, establishing a voltage gradient across neuronal membranes, known as the membrane potential (Liang et al., 2015). This potential is not merely a passive occurrence; it is an observable and measurable phenomenon that is pivotal for understanding the electrophysiological underpinnings of human cognition (Roohi-Azizi et al., 2017).

Electroencephalograms, known as EEGs, stand out among brain imaging modalities (Lestari et al., 2020) for their ability to capture and graphically represent the membrane potential of brain cells through distinct waveforms. Its operational essence lies in identifying neuronal fluctuations, evidenced by characteristic spikes and interictal waves within the EEG spectra (Andrade-Machado et al., 2021).

On the other hand, there is a contemporary trend recognizing that women can also occupy leadership roles (Pierli et al., 2022), suggesting that the potential for job-related stress as a leader may also arise in females (Galsanjigmed & Sekiguchi, 2023). Furthermore, questions often emerge regarding whether there are differences between male and female brains. Numerous studies have sought to explore this issue. According to gender, there appears to be no inherent difference between the two (Joel, 2011). However, the brain is highly plastic (Kolb et al., 1998), meaning that its function is significantly shaped by life experiences, which implies that gender may influence how the brain responds to situations (Ristori et al., 2013). This raises the question as to whether the effects of istighfar exhibit any gender-specific variations.

This study aimed to explore whether EEG can be utilized to discern an individual's brain activity during episodes of anxiety followed by istighfar smoking and whether there are differences in patterns between males and females.

2. Materials and Methods

The investigation (Figure 1) took place at the Integrated Science Laboratory of Universitas Islam Negeri Walisongo Semarang, where a meticulous selection process was undertaken to recruit participants who met a stringent set of inclusion and exclusion criteria. Specifically, individuals were screened to ensure that they were free of neurological and mental disorders, right-handed, and not receiving any medical treatment. A cohort of 24 young adults, evenly split between sexes, was assembled for the study.

![Figure 1 Flowchart.](https://www.malque.pub/ojs/index.php/msj)

This research utilized the EEG Contex KT88 device, which involves the strategic placement of electrodes in accordance with the internationally recognized 10–20 system and incorporates 16 channels (Figure 2). Data processing was rigorously confined to the frontal cortex, predicated on the premise that EEG can reveal activation patterns in this region correlated with emotional dysregulation across the lifespan. Each participant had six sets of data representing frontal electrode pairs (Fp1, Fp2, F3, F4, F7, F8) with ear electrodes (A1 and A2), namely, Fp1-A1, Fp2-A2, F3-A1, F4-A2, F7-A1, and F8-A2. The analysis in this study exclusively focused on the alpha and beta brain wave frequencies.

The EEG recording protocol was carefully structured (Figure 3): initially, participants were instructed to focus on a red dot displayed on a screen for one minute to establish a baseline. This was followed by a three-minute period during which stimuli intended to elicit anxiety were introduced. Subsequently, the participants engaged in an istighfar dhikr for another
three minutes as a form of spiritual intervention. The form of dhikr applied in this research is kahfi, wherein participants silently recited istighfar in their hearts. In the final phase, attention was redirected to the red dots for 60 seconds to evaluate the reconcentration ability.

Figure 2 Collecting EEG data.

Figure 3 The EEG recording protocol.

Upon collection, the data were stored in the European Data Format (EDF) and processed using the power spectral density (PSD) algorithm, a technique designed to convert temporal information into the frequency domain, thereby facilitating a more nuanced analysis of brain activity. Subsequent data examination was performed utilizing the Statistical Package for the Social Sciences (SPSS) software, which employs binary logistic regression—a statistical technique that assesses the probability of occurrence of a binary outcome in relation to one or more predictor variables.

The application of binary logistic regression was specifically aimed at discerning the comparative dynamics of alpha and beta brain waves between males and females in states of anxiety and at evaluating the modulation of these waves by the istighfar dhikr intervention. This nuanced approach allowed the researchers to dissect the intricate patterns of cerebral response under these specific conditions, contributing valuable insights to the field of neuropsychological research.

3. Results

Our investigation revealed an increase in both alpha (Figure 4(a)) and beta (Figure 4(b)) brain wave frequencies among male and female subjects in the istighfar state relative to the anxiety state, with the exception of a single female subject who exhibited an increase in beta wave amplitude. The average intensity of alpha and beta brain waves in the anxiety and istighfar conditions is presented in the bar graph, as depicted in Figure 5. The average alpha and beta brain wave values increased from anxiety to istighfar dhikr conditions, both in males and females. Nevertheless, regression analysis indicated a predominance of alpha wave alterations among males, as opposed to beta wave changes in females (Table 1).
Figure 4: Extraction of brain waves using the PSD algorithm on (a) alpha waves in anxious conditions and (b) beta waves in istighfar dhikr conditions.

Figure 5: Average intensity of alpha and beta brain waves under conditions of anxiety and dhikr.

Table 1: Logistic binary regression test results.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Brainwave</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Alpha</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>Beta</td>
<td>0.188</td>
</tr>
<tr>
<td>Female</td>
<td>Alpha</td>
<td>0.996</td>
</tr>
<tr>
<td></td>
<td>Beta</td>
<td>0.032</td>
</tr>
</tbody>
</table>
4. Discussion

Our findings related to the increased dominance of alpha waves suggest the occurrence of emotional stability (Pavlenko et al., 2009), which in our study occurred when participants of both genders quickly engaged in istighfar following stimulation of anxious situations. The tendency for lower alpha wave dominance during istighfar aligns with the reduced dominance also observed in conditions such as depression (Baehr et al., 2009; Kan & Lee, 2015).

Furthermore, an increase in alpha waves, which is indicative of emotional stability (Pavlenko et al., 2009), was observed concurrently with an increase in beta waves in this study. This could be attributed to a variety of factors, such as situations where an individual is triggered by thoughts or emotions related to the religious dimension (Julianto & Etsem, 2015; Kinan, 2015). A similar phenomenon was noted during times when individuals were listening to Quranic recitation (Moulaei et al., 2023). Intriguingly, a comprehensive brain region analysis encompassing all EEG channels revealed a decrease in beta wave dominance (Tasyakuranti et al., 2022). This difference is likely due to the variance in the breadth of the brain regions we examined.

Due to anxiety, the unprecedented global crisis has inflicted widespread damage across physical, economic, and social spheres; however, it has inadvertently fostered enhanced recognition and dialog concerning mental well-being (Podubinski et al., 2023). Among the spectrum of mental health concerns, anxiety (Poulin et al., 2004) has emerged as a prevalent issue among professionals across various industrial sectors. Within leadership roles, heightened levels of anxiety can disrupt cognitive processes (Robinson et al., 2013), potentially undermining leaders’ capacity to fulfill their obligations effectively and compromising their leadership efficacy. Among the myriad interventions available to ameliorate anxiety, Islamic religious scholarship suggests dhikr as a potentially potent and practical method (Saged et al., 2022; Zahraa & Sulistyarini, 2023). This practice, rooted in spiritual tradition, has been posited as a viable option to restore mental wellness (Sulistyawati et al., 2019), offering a harmonious blend of efficacy and ease of implementation that could be especially beneficial for those in leadership positions grappling with the demands of their roles. This research endeavors to elucidate, with minimal bias, the effects of istighfar dhikr on the cerebral response during states of anxiety.

There are three virtues associated with istighfar dhikrs: the granting of relief by Allah in every difficulty faced by humans (Muchamad Toif Chasani, 2022; Raya, 2018; Woodruff, 2013); the acquisition of guidance for solutions to problems encountered (Abidin, 2016; Affandi et al., 2020; Mubasyaroh, 2019); and the bestowal of unexpected sustenance (Applebaum, 2019). Dhikr is categorized into three types: “jali,” articulated clearly through spoken words (Applebaum, 2019; Geels, 1996); “khafi,” contemplated deeply within the heart without vocalization (Munsoor & Sa’ari, 2017); and “haqiqi,” performed by engaging the entirety of one’s physical and spiritual being (Abuali, 2020). However, in this study, to minimize the possibility of EEG data artifacts, physical movements were kept to an absolute minimum.

Our findings indicate that when applied during stress, istighfar dhikr objectively facilitates the alleviation of anxiety, as indicated by changes in the dominance of alpha and beta waves in the frontal region of the human brain. We believe this supports the advancement of da’wah efforts, encouraging individuals to continually remember Allah in their daily lives.

5. Conclusions

Using EEG, a study was conducted to examine the influence of istighfar dhikrs on anxiety in adolescents stratified by sex. The research results indicate a meaningful difference in alpha brain waves in males, with a sig. value of 0.016 (p<0.05), while in females, this difference occurs in beta brain waves, with a sig. value of 0.032 (p<0.05). Moreover, beta brain waves in males (sig. 0.188) and alpha waves in females (0.996) did not experience meaningful differences (p>0.05). The findings of this study revealed a gender-based divergence in neural dominance postistighfar: males predominantly exhibited alpha wave activity, whereas females showed a pronounced shift in beta wave activity.

Acknowledgments

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Ethical considerations

The research was conducted with Ethical Clearance provided by Universitas Islam Negeri Walisongo number: 2058/Un.10.8/D/HK.06.01/03/2024.

Conflict of interest

The authors declare no conflicts of interest.

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