

Global Research Trends in the Application of Neuroimaging Modalities on Quranic Research: A Bibliometric Analysis (2009–2023)

Nurfaizatul Aisyah Ab Aziz*, Nurul Hanim Nasaruddin[†], Nurul Izzah Isham[‡], Mas Syazwanee Shab[§], Mohammed Abdalla Kannan[¶] and Muzaimi Mustapha^{**}

This bibliometric analysis aims to identify publications from 2009 to 2023 on the Holy Quran that employed neuroimaging modalities (referred herein as “neuroQuran”). Researchers increasingly use neuroimaging methods to understand how the brain engages with the Holy Quran during recitation, listening, and memorization. Recognizing the current research status and gaps in neuroQuran studies is crucial for planning future investigations in this field. A search of the Scopus database was performed using related keywords. NeuroQuran-related publications were retrieved from the Scopus database from 2009 to 2023. Bibliometric analyses were performed using Harzing’s Publish or Perish, Microsoft Excel, and VOS viewer software. Thirty-two documents from the Scopus database were retrieved and analyzed to answer the research questions. The highest number of publications was published in 2022, with six publications. Malaysia has published the most neuroQuran research, with a total of 20 publications. Keyword analysis, based on nine selected journal articles published 2019–2023, revealed that Electroencephalography (EEG) is the most common topic examined in neuroQuran research. EEG is also the most popular neuroimaging tool in neuroQuran research, followed by Event-Related Potential (ERP) and Magnetic Resonance Imaging (MRI). These study findings can guide future research efforts, hence offering a foundation for the potential use of the Holy Quran in complementary psychospiritual therapy.

*Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia, abnaisyah@unimas.my

[†]Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia, nnhanim@unimas.my

[‡]Faculty of Cognitive Sciences and Human Development, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia, 25020218@siswa.unimas.my

[§]Department of Neurosciences, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia, massyazwanee@gmail.com

[¶]Department of Neuroscience, Washington University School of Medicine, 63110 St. Louis, Missouri, USA, moh_kannan@hotmail.com

^{**}Department of Internal Medicine, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, 16150 Kubang Kerian, Kelantan, Malaysia, mmuzaimi@usm.my

Correspondence concerning this article should be addressed to Dr Nurfaizatul Aisyah Ab Aziz and Assoc. Prof. Dr Muzaimi Mustapha

doi: 10.3998/jmmh.5745

Conflicts of interest:

The authors have no competing interests to declare.

Keywords

Holy Quran • neuroimaging • EEG • MRI • complementary therapy

Introduction

The Quran has long been used as a complementary therapy, especially in Muslim countries (Nadi-Ravandi & Batooli, 2022). Listening, reciting, and memorizing the Holy Quran have all been shown to improve physical and mental health among Muslim believers (Che Wan Mohd Rozali et al., 2022). This may be due to the Quran's status as the "Word of God" and the musical elements of its recitation (Ismail et al., 2023). Additionally, faithful Muslims anecdotally claim that listening to Quranic recitation can give an inner sense of calmness, leading to research on its diverse effects (Samhani et al., 2022; Vaghefi et al., 2015). Reciting (Kamal et al., 2013) and memorizing the Quran (Al-Attas, 2011; Saquib et al., 2017) have also been researched, with positive findings in the psychological and cognitive domains.

There is a growing body of research on the therapeutic effects of Quranic listening, reciting, and memorizing on various psychological disorders. One systematic review found that listening to Quranic recitation reduced anxiety in a variety of settings (Ghiasi & Keramat, 2018). Most of these studies used self-report questionnaires to measure anxiety. Neuroscientific studies have also been conducted on the effects of Quranic recitation on the brain (herein referred to as "neuroQuran" research). These studies have shown that different tasks and conditions elicit different neural correlates when people are presented with different types of Quranic auditory stimuli (Abdullah & Omar, 2011; Kannan et al., 2022).

Despite the growing interest in the intersection of neuroQuran studies, there is a paucity of research utilizing neuroimaging and neurosignal techniques to examine the effects of Quranic recitation on the brain, compared with studies that rely on self-report questionnaires. The brain, the command center for all bodily functions enabled by an interconnected network of neural synapses, is the biological hardware foundation from which all thoughts, perceptions, feelings, and behavior emerge (Fornito et al., 2016). This foundation is made possible by the unconscious neural processes that may contribute to certain behaviors, which self-report measures typically overlook (Alsharif et al., 2021; Samsuri et al., 2023).

Neuroimaging tools, such as Electroencephalography (EEG), Event-Related Potential (ERP), Magnetoencephalography (MEG), functional Magnetic Resonance Imaging (fMRI), and Positron Emission Tomography (PET), provide valuable insights into the neural underpinnings of Quranic listening, recitation, and memorization. By investigating the neural correlates of these processes, we can gain a deeper understanding of the cognitive and emotional mechanisms involved in Quranic engagement.

This neuroQuran research that incorporates these neuroimaging techniques can provide a solid foundation for the use of Quranic therapy in complementary therapy, especially for psychological and mental well-being. Quranic therapy is widely accepted among Muslims, but is less known outside of the Muslim community. There is a paucity of evidence from Western countries on the use of the Holy Quran to support mental health and well-being, which suggests a lack of cultural accommodation (Owens et al., 2023). To ensure that the use of Quranic therapy can transcend its cultural and religious specificity, more high-quality research is needed in this domain. This is especially important in the scientific world, which demands critical inquiry and evaluation.

A bibliometric analysis is therefore required to track the progress of neuroQuran research that incorporates neuroimaging and examines and visualizes the literature to date. Previous bibliometric studies on the Holy Quran focused on physics studies (Arrizkiyah et al., 2021), the application of

the Holy Quran and hadith in healthcare settings (Nadi-Ravandi & Batooli, 2022), and the Holy Quran as therapy for mental and physical diseases (Abdekhoda & Ranjbaran, 2022). This is the first bibliometric research study on the Holy Quran that incorporates neuroimaging modalities.

This bibliometric research study examines scholarly articles from the Scopus database specifically on neuroQuran research, which is the study of the neural underpinnings of Holy Quran listening, recitation, and memorization using techniques such as EEG, ERP, fMRI, and MEG. Answering the following research questions will provide a comprehensive understanding of the current trend in empirical neuroQuran research:

- RQ1: What are the most-cited articles in the neuroQuran research domain between 2009 and 2023?
- RQ2: What countries, institutions and authors that produced the highest number of publication in the neuroQuran research domain between 2009 and 2023?
- RQ3: What are the studies that employed neuroimaging modalities in the five years 2019–2023?

This paper presents the methodology and data collection techniques in Section 2, the analysis of the bibliometric data in Section 3, and the discussion and conclusion of the study in Sections 4 and 5.

Method

This paper encapsulates the mixed application of qualitative and quantitative techniques in which bibliometric study is used (Donthu et al., 2021). Data collection was carried out in October 2023 from the Scopus database. The Scopus database was launched in 2004 by Elsevier and has earned its place as a comprehensive and well-established bibliographic data source (Pranckutė, 2021). It indexes more than 25,000 journals from around the world from more than 7,000 publishers, and provides comprehensive coverage of scientific, technical, medical, and social science fields (Elsevier, 2023; Pranckutė, 2021; Zhu & Liu, 2020). It also provides detailed citation information, including the number of times an article has been cited, and a variety of metrics to evaluate the impact of research, including the *h*-index and Scimago Journal Rank (Harzing & Alakangas, 2015).

Data was collected from the Scopus database from the year 2009 to 2023. Keywords such as “Quran,” “al-Quran,” “quranic,” “Holy Scripture,” “fatihah,” “neuro,” “MRI,” “EEG,” “ERP,” “MEG,” and Boolean operators, such as “AND” and “OR,” were used for database searching. One-hundred and nine articles were retrieved. The titles and abstracts of the articles were then reviewed, and thirty-two articles met the research criteria. The query was as follows: (TITLE-ABS-KEY (“quran” OR “al-Quran” OR “Quranic” OR “Holy Scripture” OR “fatihah”)) AND (“meg” OR “eeg” OR “erp” OR “mri” OR “neuro”).

For the bibliometric analysis, the study used the co-occurrence of words or terms in the data corpus, specifically from the titles and abstracts. VOSviewer was used to analyze the citation data. In addition, Harzing’s Publish or Perish and Microsoft® Excel were incorporated for data cross-checking purposes and to analyze the productivity of individual authors and citation analysis in neuroQuran research. The productivity of individual authors was measured by counting the total number of publications each author produced during the study period (2009–2023).

Meanwhile, citation analysis was used to understand the formation, scope, and direction of research streams in neuroQuran research. Citation analysis is a bibliometric method that counts the number of times other articles cite a particular article to measure the reputation and impact of that publication in a particular field of scientific research (Kumar et al., 2020).

Using VOSviewer, keyword analysis was done. Keyword analysis is a useful quantitative tool for investigating specific topics in neuroQuran research and identifying trends. It is based on the assumption that keywords provide a coherent representation of the content of the documents in which they are used. This approach has been widely used in recent years (Alsharif et al., 2021; Wang & Chai, 2018).

Bibliometrics encompasses four main analysis methods: co-word association, co-word cluster, co-word frequency, and burst word monitoring (Alsharif et al., 2021). Of particular note is co-word analysis, which examines co-occurring keywords. The connection between two keywords is represented by a numerical value, which demonstrates the relationship between them; the higher the value, the stronger the link (Ahmi, 2022; Goyal & Kumar, 2021). The link strength between two keywords represents the number of times they occur together in the same article, and the total number of these links refers to the total number of times these two keywords occur together. For this present study, in VOSviewer, the minimum number of occurrences of a keyword for it to be displayed was set to three. This means a keyword will appear on the bibliometric map if it occurs together with another keyword in a document more than three times.

The study adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, as recommended by Moher et al. (2015) and Alsharif et al. (2021), to address research questions (RQ) 1, 2, and 3. For RQ1 and RQ2, a bibliometric analysis was employed to explore global trends in neuroQuran research from 2009 to 2023. This analysis offers insights into the leading journals, authors, countries, and academic institutions contributing to neuroQuran research, while also identifying the most-cited articles on relevant topics from publications spanning 2009 to 2023. In addressing RQ3, nine empirical journal articles of the 32 articles identified within the neuroQuran research field were specifically chosen, focusing on the five years of 2019 to 2023. The data are presented in Table 7. This combined approach, integrating the selected articles with bibliometric analysis, contributed to a comprehensive evaluation of the neuroQuran research development and current status. In addition, it provided suggestions for meaningful future research (Block & Fisch, 2020). Moreover, focusing the analysis on the years 2019–2023 ensures that the data is current and reflects the rapidly changing trends and advancements in neuroQuran research. As a result, a focus on the most recent research findings, methodologies, and technologies in this field is feasible.

As depicted in Figure 1, empirical journal articles published between 2019 and 2023 were included in answering RQ3. Any other documents, such as conference papers, reviews, and letters, and any publications in a non-English language were excluded. After reviewing 32 full-text documents one-by-one, a total of nine journal articles were selected for this study to address RQ3.

Results

The Number of Documents, Types of Documents, and Source Types

From the Scopus database, 32 documents related to neuroQuran research were reviewed and analyzed. The first article on neuroQuran research was published in 2009 (Figure 2). No studies were published in 2010, 2013, or 2018. The years 2022 and 2023 had the highest number of publications, with six and five articles published, respectively. The highest number of citations occurred in 2016, with 50 citations.

Table 1 shows that 53.13% of the documents published in this area of research were research articles, followed by conference papers (37.05%), review articles (6.25%), and letters (3.13%). Table 2 shows that more than half of the documents were published in journals, with the rest published in conference proceedings.

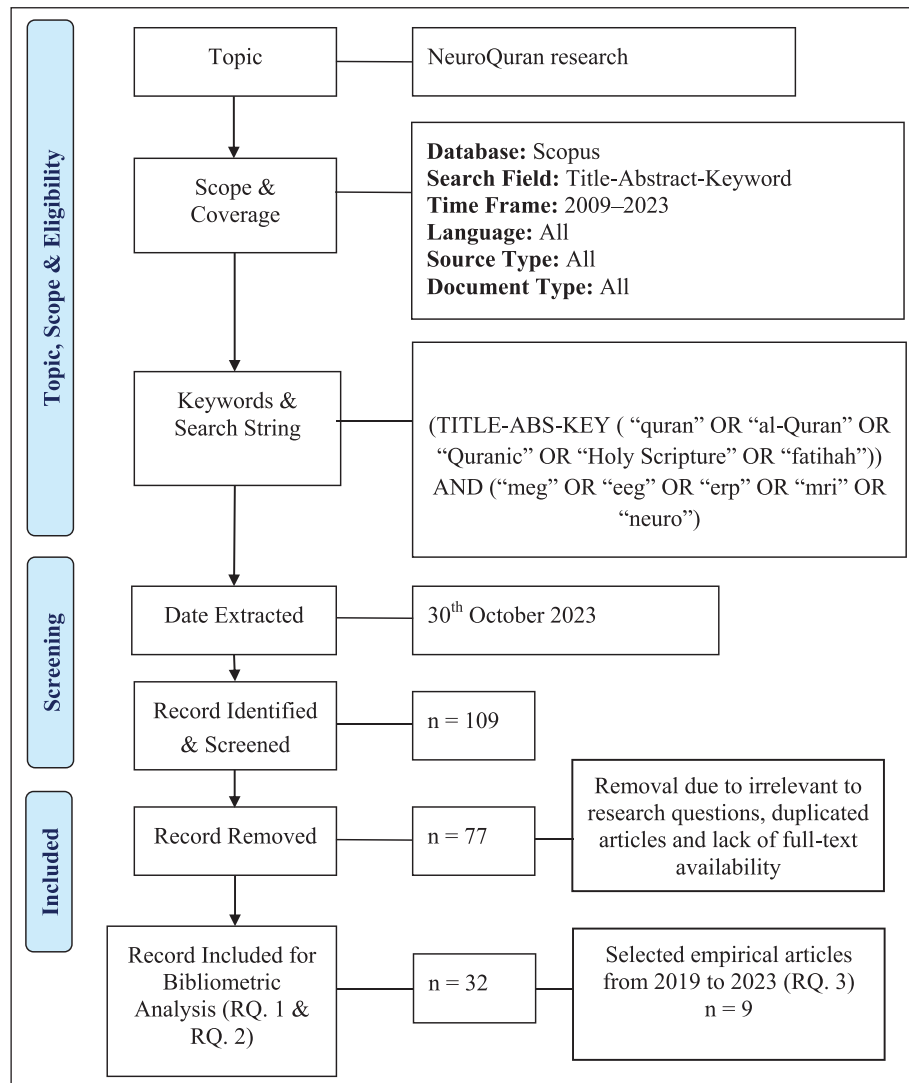


Figure 1. Summary flow diagram of the search strategy.

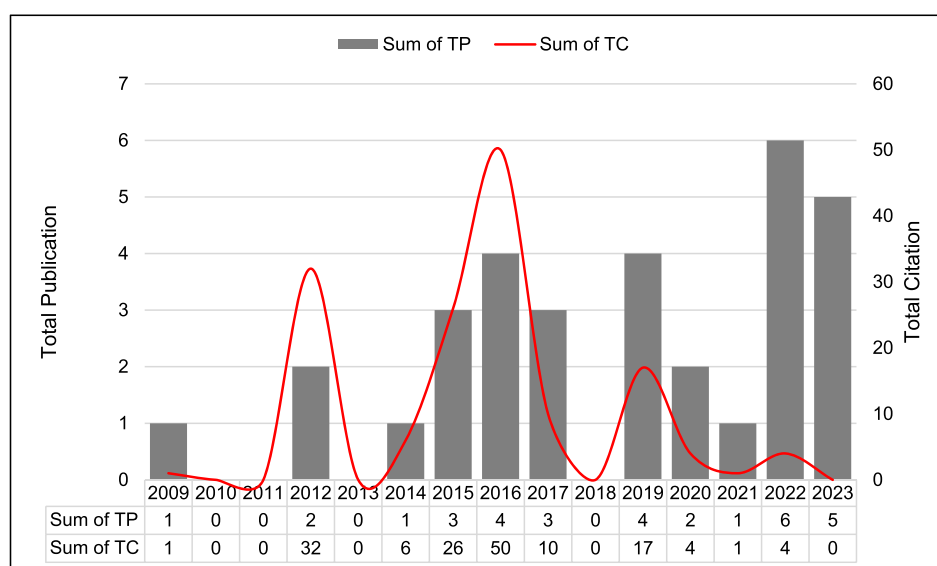


Figure 2. Number of publications and citations in the neuroQuran research showing Total Publications (TP) and Total Citations (TC).

Table 1. Types of documents.

Document Type	Number of documents	Percentage (%)
Article	17	53.13
Review	2	6.25
Conference Paper	12	37.50
Book chapter	0	0
Note	0	0
Letter	1	3.13
Erratum	0	0
Short survey	0	0
Erratum	0	0
Editorial	0	0
Total	32	100.00

Table 2. Source Type.

Source Type	Total Publications (TP)	Percentage (%)
Journal	20	62.50
Book	0	0
Book Series	0	0
Conference Proceeding	12	37.50
Total	32	100.00

Leading Countries and Institutions

Table 3 shows that Malaysia published more than half of the 32 documents in this study, making it a key player in neuroQuran research. Eight of the twenty publications were published by the International Islamic University Malaysia. Iran is second, with six publications, followed by Indonesia and Pakistan, each with three. Saudi Arabia and Japan have two publications each, and Bangladesh, Oman, Kuwait, and Nigeria each have one publication. Islamic Azad University in Iran is the second most productive academic institution in this study, with four publications. King Abdulaziz University (Saudi Arabia) and the University of Engineering and Technology (Pakistan) follow with two publications each. Universitas Sebelas Maret, Universitas Islam, Institut Teknologi Surabaya, Tokai University, Shibaura Institute of Technology, United International University, Gulf University for Science and Technology, and Lagos State University each published one paper. Finally, the Directorate of Diagnostic Imaging & Intervention Radiology, Ministry of Health in Oman, is the only non-academic institution that published a paper.

Table 3. Ten leading countries and institutions in neuroQuran research.

No.	Country	TP	The leading institution	TPi
1	Malaysia	20	International Islamic University Malaysia	8
2	Iran	6	Islamic Azad University	4
3	Indonesia	3	Universitas Sebelas Maret, Universitas Islam, Institut Teknologi Surabaya	1
4	Pakistan	3	University of Engineering and Technology	2
5	Saudi Arabia	2	King Abdulaziz University	2
6	Japan	2	Tokai University, Shibaura Institute of Technology	1
7	Bangladesh	1	United International University	1
8	Oman	1	Directorate of Diagnostic Imaging & Intervention Radiology, Ministry of Health Oman	1
9	Kuwait	1	Gulf University for Science and Technology	1
10	Nigeria	1	Lagos State University	1

TP: total publications; TPi: total publication by institutions.

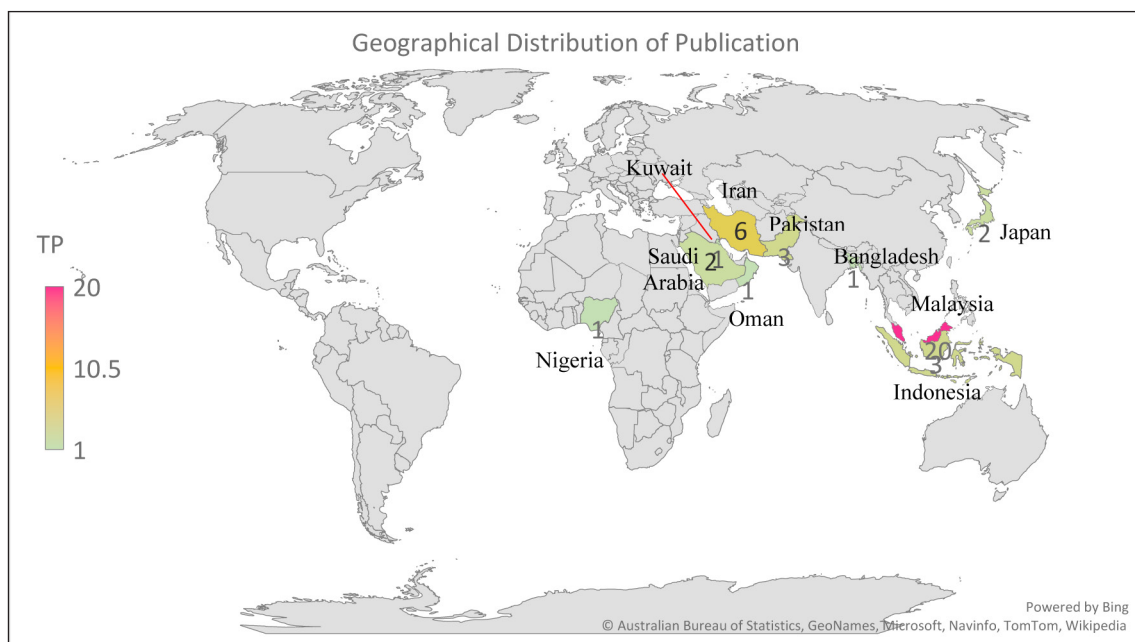
**Figure 3.** Geographical distribution of publications.

Figure 3 shows the geographical distribution of publications. Most of the countries involved in the neuroQuran publications resided in the Asian continent, with Nigeria in Africa being the exception.

Leading Authors

As shown in Table 4, the top ten authors with the most published articles in neuroQuran research were from only two countries: Malaysia and Iran. The author with the most publications

on the topic is Mohammed Faruque Reza, who has published six papers, has an *h*-index of 3, and has been cited 8 times. The second, third, fourth, and fifth most productive authors on the list are Samhani Ismail, (4 papers, 7 citations), Hafizan Juahir, (4 papers, 7 citations), Shahriar Gharibzadeh, (3 papers, 23 citations), and Mohd Hanifah Jusoh, (3 papers, 4 citations). Mohammad Reza Mohammadi, Imad Fakhri Taha Alshaikhli, and Sabaa Ahmed Yahya Al-Galal. have each published three papers, with Mohammad Reza Mohammadi having the highest total citations of 40 among all of the authors. Iqbal Bin Jamaluddin, and Mahsa Vaghefi from Malaysia and Iran respectively, have each published two papers.

Table 4. The ten leading authors in neuroQuran research.

No.	Author's name	Year of 1 st Publication	TP	TC	<i>h</i> -index	Affiliation	Country
1	Reza, M.F.	2012	6	8	3	Universiti Sains Malaysia	Malaysia
2	Ismail, S.	2019	4	7	4	Universiti Sultan Zainal Abidin	Malaysia
3	Juahir, H.	2019	4	7	31	Universiti Sultan Zainal Abidin	Malaysia
4	Gharibzadeh, S.	2015	3	23	18	Amirkabir University of Technology	Iran
5	Jusoh, M.H.	2022	3	4	2	Universiti Sains Malaysia	Malaysia
6	Mohammadi, M.R.	2015	3	19	40	Tehran University of Medical Sciences	Iran
7	Alshaikhli, I.F.T.	2014	3	29	10	International Islamic University Malaysia	Malaysia
8	Al-Galal, S.A.Y.	2014	3	29	4	International Islamic University Malaysia	Malaysia
9	Jamaludin, I.	2016	2	3	2	International Islamic University Malaysia	Malaysia
10	Vaghefi, M.	2015	2	19	3	Islamic Azad University	Iran

TP: total publications; TC: total citations.

Journal Outcomes

The five journals with the most published articles in neuroQuran research were published by five different publishers, as shown in Table 5. Penerbit UTM Press published the most documents (three) in the Malaysian Journal of Fundamental and Applied Sciences. Wolters Kluwer Health (Journal of Medical Signals and Sensors), Springer Verlag (IFMBE Proceedings), and Ibn Sina Trust (Bangladesh Journal of Medical Science) each published two documents. Taylor & Francis published one document in the Journal of Medical Engineering and Technology. The Journal of Medical Engineering and Technology had the highest citation count (12) despite only publishing one document. The Malaysian Journal of Fundamental and Applied Sciences and the Journal of Medical Signals and Sensors each published three and two documents, respectively, with seven total citations each. The IFMBE Proceedings journal published the least cited document (three citations).

Leading Citations

Citation analysis was used to identify the top ten most influential articles in neuroQuran research based on total citations per year (TC), as shown in Table 6. TC is the number of times an article has been cited by other articles in the Scopus database (Ahmi, 2022).

Table 5. The five journals with most published articles on neuroQuran research.

No.	Journal	TP	TC	Cite Score 2022	The most cited articles	Time cited	Publisher
1	Malaysian Journal of Fundamental and Applied Sciences	3	7	1.6	Electroencephalography (EEG) analysis on human reflection towards relaxation of mind	6	Penerbit UTM Press
2	Journal of Medical Signals and Sensors	2	7	2.5	Nonlinear analysis of electroencephalogram signals while listening to the holy Quran	7	Wolters Kluwer Health
3	IFMBE Proceedings	2	3	0.9	Grey matter volume differences of textual memorization: A Voxel based morphometry study	3	Springer Verlag
4	Bangladesh Journal of Medical Science	2	6	1.5	Activation of mental imagery neural network revealed during listening to Fatihah Chapter; a neuroimaging study	3	Ibn Sina Trust
5	Journal of Medical Engineering and Technology	1	12	3.6	Spirituality and brain waves	12	Taylor & Francis

TP: total publications; TC: total citations.

The three most cited documents were published by the same publisher, IEEE, in three different journals or proceedings, as shown in Table 6. The most cited document was published by Zulkurnaini et al. in 2012 and is titled “The comparison between listening to Al-Quran and listening to classical music on the brainwave signal for the alpha band.” It has been cited 31 times. The least cited document on the list was published by Rahman et al. in 2020 and is titled “Association between scripture memorization and brain atrophy using magnetic resonance imaging,” with three citations.

Table 6. Top ten articles on the Scopus database ordered by citation score.

No.	First Author/Year	Title	Journal/Proceeding	Publisher	TC 2023
1	Zulkurnaini et al. (2012)	The comparison between listening to Al-Quran and listening to classical music on the brainwave signal for the alpha band	Proceedings – 3rd International Conference on Intelligent Systems Modelling and Simulation, ISMS 2012	IEEE	31
2	Alsolamy and Fattouh (2016)	Emotion estimation from EEG signals during listening to Quran using PSD features	Proceedings – CSIT 2016: 2016 7th International Conference on Computer Science and Information Technology	IEEE	30
3	Al-Galal et al. (2016)	EEG-based emotion recognition while listening to Quran recitation compared with relaxing music using valence-arousal model	Proceedings – 2015 4th International Conference on Advanced Computer Science Applications and Technologies	IEEE	14
4	Vaghefi et al. (2015)	Spirituality and brain waves	Journal of Medical Engineering and Technology	Taylor & Francis	12
5	Alhouseini et al. (2015)	Stress assessment while listening to Quran recitation	Proceedings – 2014 International Conference on Computer Assisted System in Health	IEEE	11
6	Al-Galal et al. (2017)	Automatic emotion recognition based on EEG and ECG signals while listening to quranic recitation compared with listening to music.	Proceedings – 6th International Conference on Information and Communication Technology for the Muslim World	IEEE	9

(Contd.)

No.	First Author/Year	Title	Journal/Proceeding	Publisher	TC 2023
7	Vaghefi et al. (2019)	Nonlinear analysis of electroencephalogram signals while listening to the holy Quran	Journal of Medical Signals and Sensors	Wolters Kluwer Health	7
8	Jalaudin and Mohammed Amin (2019)	Electroencephalography (EEG) analysis on human reflection towards relaxation of mind.	Malaysian Journal of Fundamental and Applied Sciences	Penerbit UTM Press	6
9	Alshaikhli et al. (2014)	A study on the effects of EEG and ECG signals while listening to Qur'an recitation	5th International Conference on Information and Communication Technology for The Muslim World	IEEE	6
10	Rahman et al. (2020)	Association between scripture memorization and brain atrophy using magnetic resonance imaging	Acta Neurobiologiae Experimentalis	Nencki Institute of Experimental Biology	3

TC: total citations; ECG: electrocardiography.

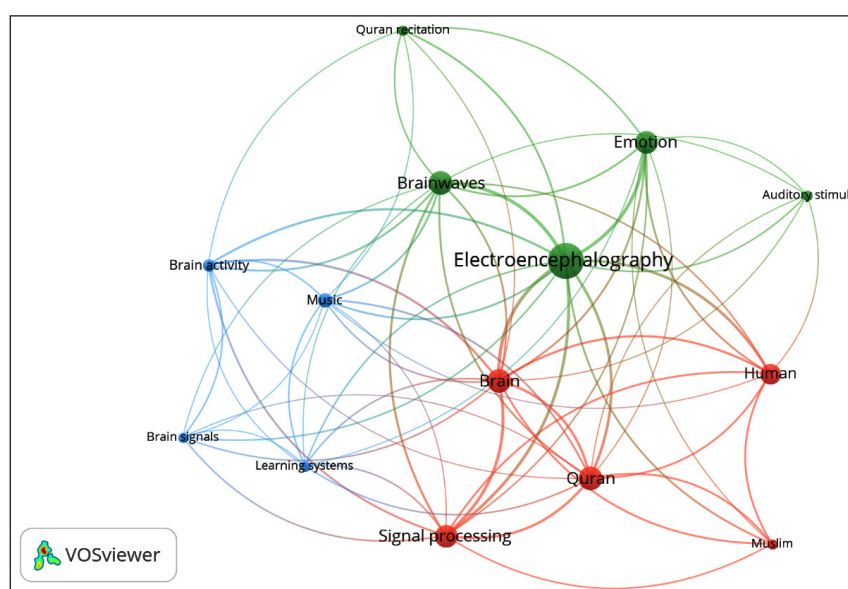


Figure 4. Scientometrics map of keywords co-occurrence (minimum of three occurrences).

Keyword Analysis

The keyword co-occurrence analysis in this study used 281 keywords from 32 documents. The keywords were inserted into VOSviewer to create a map of the literature with a minimum of three occurrences, and 22 keywords met this threshold, as shown in (see Figure 4).

The scientometrics map shows three clusters of keyword occurrences in neuroQuran research. Cluster 1 (red) shows the relationship between the brain, the Quran, and signal processing. Cluster 2 (green) shows the popularity of electroencephalography (EEG) as a neuroimaging device in neuroQuran research, where EEG is used to record brainwaves while participants listen to Quranic recitation. Cluster 3 (blue) shows the relationship between brain activity, brain signals, and music.

From Figure 4, it can be seen that “electroencephalography” is the topmost keyword concerning neuroQuran research (20 occurrences, 65 total link strength). Further, “Quran,” “brain,” and “brainwaves” were observed to be highly associated with neuroQuran research, with 11 occurrences for all and 34, 46, and 35 total link strength, respectively. “Signal processing” and “emotion” also had a strong association with neuroQuran research (10 occurrences, 38 total link strength, and 10 occurrences, 26 total link strength, respectively).

Selected Journal Articles

Table 7 details a summary of the nine selected journal articles in neuroQuran research for the five years (2019–2023). As shown in the table, four studies used EEG as the preferred neuroimaging technique to study the neural underpinnings of Quranic recitation. Two studies used MRI and ERP, and one study used fMRI. One study incorporated EEG and electrocardiography (ECG) as tools to assess the physiological changes of the subjects. This review acknowledges the major contributions and findings of each study, as well as their limitations.

Discussion

This review provides an overview of the neuroQuran studies that used neuroimaging techniques between 2009 and 2023 to answer research questions (RQ1, RQ2, and RQ3) through bibliometric analysis. The study revealed a clear interest in neuroQuran studies from 2009 to 2023, with EEG, ERP, MRI, and fMRI being the most common neuroimaging approaches used. The findings reveal a consistent scholarly interest in neuroQuran research over the past 15 years, though the relatively small corpus of 32 publications indicates this remains a niche area of study.

The most common keywords in neuroQuran research were EEG, Quran, brain, and brainwaves (Figure 3). The highest number of publications was six articles in 2022, with a total of four citations (Figure 1). In recent years, there has been an increase in the number of neuroQuran studies using a variety of neuroimaging methods. This indicates that researchers are trying to provide empirical evidence to support the anecdotal evidence that the Quran can be used as a complementary therapy.

Geographical analysis shows that research productivity is concentrated in Muslim-majority nations, including Malaysia, Iran, Indonesia, Pakistan, and Saudi Arabia, though important collaborations with non-Muslim-majority countries like Japan are evident. Based on this study's findings, these international partnerships appear to be driven by the need for specialized expertise in data and signal processing, highlighting the interdisciplinary nature of neuroQuran research, as collaboration with imaging and engineering experts is necessary to ensure the accuracy of the findings.

Publication patterns (Table 5) reveal a decentralized field, with five different publishers contributing substantially, led by Penerbit UTM Press with three publications in the Malaysian Journal of Fundamental and Applied Sciences. The distribution of publications across five different publishers demonstrates that this field is developing through diverse academic channels rather than being concentrated within a single publishing entity.

Table 7. Summary of the selected journal articles (2019–2023) to identify the titles, findings, and limitations of the studies.

No.	Author & year	Title	Methods (Device)	Major Contribution	Main findings	Limitation of study
1	Sheibani et al. (2023)	Study of interactive variation between brain and heart signals while listening to the Holy Quran by fusion technique	EEG and ECG	Studying the effect of Quran listening on the brain and heart signals by integrating both signals.	High accuracy was obtained when incorporating both signals compared with the ECG signal alone.	There could be gender bias as all of the subjects were female.
2	Ismail, Reza, et al. (2023)	Psychospiritual healing from al-Quran: internal aesthetic factor of quranic sound and its effects in activating greater brain regions	EEG	Analyzing both the internal factor of Quranic rhythm and its impact on the brain signals.	Quran listening activates a large brain network and increases neuronal communication and synchronization and integration.	Arabic news, unlike Quranic recitation, may have a monotone rhythm.
3	AlMahrouqi and Mostafa (2023)	Neural correlates of Quran recitals: a functional magnetic resonance imaging (fMRI) analysis	fMRI	Exploring the neural correlates of Quran recitation using block design fMRI paradigm.	Listening to Quran recitation activates empathy, mentalizing, and episodic memory neural networks.	Limited sample size for each of the three groups.
4	Ismail et al. (2022)	Activation of mental imagery neural network revealed during listening to Fatimah Chapter; a neuroimaging study	EEG	Explored the role of beta brainwaves in neuroQuran research.	Quran listening reduces the left occipital lobe beta power spectrum, indicating visual mental imagery.	Focusing only on one brain region that is the occipital lobe.
5	Akbari et al. (2022)	Evaluating the effect of Quran memorizing on the event-related potential features by using graphs created from the neural gas networks	ERP	Investigated the brain signal differences between Quran memorizer and non-memorizer through features extracted from ERP signal.	Low-frequency components increase in Quran memorizers, representing patience, concentration, and relaxation.	Limited sample size between the two groups.

(Contd.)

No.	Author & year	Title	Methods (Device)	Major Contribution	Main findings	Limitation of study
6	Akbari et al. (2022)	Evaluating the event-related potentials relevant to two groups of the Quran memorizers and non-memorizers during the retrieval phase of the visual memory	ERP	Analyzing the reaction time of the Quran memorizers and non-memorizers during the memory task.	Quran memorizers have slower reaction times as memorizing affects the networks engaged in diagnosis stimuli.	Limited sample size between the two groups.
7	Jamaludin et al. (2022)	Volume of interest-based fractal analysis of Huffaz's brain	MRI	Demonstrating the structural difference of the brain between Quran memorizers (Huffaz) and non-memorizers using fractal analysis.	Angular gyrus, medial temporal gyrus, anterior cingulate, fusiform gyrus, inferior temporal gyrus, and frontal lobe showed significant volume differences between huffaz and non-huffaz.	The cognitive and psychological assessment was not done.
8	Rahman et al. (2020)	Association between scripture memorization and brain atrophy using magnetic resonance imaging	MRI	Exploring the brain structural difference between persons who completely memorize the Quran, partially memorize the Quran and persons who did not memorize the Quran.	Quran memorizers had larger grey and white matter volumes than controls.	The cognitive and psychological assessment was not done.
9	Vaghefi et al. (2019)	Nonlinear analysis of electroencephalogram signals while listening to the Holy Quran	EEG	Investigating the nonlinear analysis of EEG signals.	Quran listening increases brain complexity and dynamicality.	Only one type of Quranic recitation is used.

EEG: Electroencephalography; ERP: Event-related potential; ECG: Electrocardiography; fMRI: Functional magnetic resonance imaging; MRI: Magnetic resonance imaging.

The citation analysis presents particularly intriguing insights, as the Journal of Medical Engineering and Technology achieved the highest citation count (12) despite publishing only one document, suggesting that engineering-focused neuroQuran research may have a greater academic impact. The field's technical orientation is further evidenced by the predominance of IEEE publications, with six of the top ten studies appearing in their conference proceedings (Table 6). The higher citation performance of technical journals further supports the current predominance of signal processing and neuroimaging approaches in this field. As IEEE is known for engineering and computer science, it makes sense that these studies focus on technical methods like EEG and fMRI or other neuroimaging modalities to analyze brain responses to Quranic stimuli.

This trend is also seen by the keyword analysis (Figure 4), where “signal processing” emerges as one of the most frequent co-occurring terms. The prominence of this keyword aligns with the dominance of IEEE publications, confirming that neuroQuran research primarily focuses on quantitative brain signal analysis rather than subjective or theological interpretations. However, the presence of publications in medical science journals (e.g., Bangladesh Journal of Medical Science) suggests potential for broader interdisciplinary engagement. Of note, the most cited neuroQuran study, a 2012 IEEE conference paper by Zulkurnaini et al., exemplifies the field's strong engineering foundations. The findings reveal that neuroQuran research is predominantly shaped by signal processing and engineering approaches.

The current emphasis on signal processing suggests that future studies could benefit from integrating perspectives from Islamic psychology, neuroscience, and cognitive neuroscience to explore broader dimensions. These include emotional, spiritual, and cognitive effects, which are beyond pure neural data. Additionally, mixed methods research combining quantitative neuroimaging with qualitative assessments (e.g., self-reports or behavioral studies) could help our understanding of not just the biological effects but also the emotional and spiritual impact of Quranic recitation. As the field develops, maintaining technical rigor while broadening theoretical frameworks will be essential for advancing neuroQuran research as a distinctive area of scientific inquiry.

Table 7 summarizes the analysis of neuroQuran studies published from 2019 to 2023. It shows that EEG is the most commonly used neuroimaging modality, followed by ERP, MRI, and fMRI. This is likely because EEG is less expensive, has high temporal resolution, and is more readily available in clinical and research settings than other techniques (Kannan et al., 2022). However, the recent trend of using fMRI in neuroQuran research is encouraging, as fMRI can consolidate findings for the brain region involved in processing the Holy Quran, with high spatial resolution compared to EEG.

As seen in Table 7, neuroimaging modalities such as EEG, ERP, and fMRI offer valuable insights into the neural correlates of emotion (e.g., empathy, calmness, and motivations) and cognitive processes (e.g., attention, mental imagery, language processing, and memory) in response to Quranic recitation. Furthermore, most studies have focused on exploring the neural correlates of the effects of listening to the Holy Quran, laying the groundwork for more comprehensive studies involving advanced neuroimaging modalities and complex data analysis. Some studies have also examined structural and neuronal differences between Huffaz (Holy Quran memorizers) and non-Huffaz, which may help explain the cognitive distinctions between the two groups. However, these findings should be interpreted cautiously, as various confounding factors can influence structural and neuronal changes. High quality studies with rigorous methodologies are therefore essential in neuroQuran research to ensure reproducibility and reliability.

Taken together, the neuroQuran research can explain the neural correlates of emotion and cognitive activity in processing the Holy Quran during listening, reciting, and memorizing. An application of this research might offer measurable explanations of how the Holy Quran is processed and perceived in the individual mind, as reflected in the psychological and bodily responses of the individual.

Limitations and Delimitations of the Study

There are some limitations and delimitations with this study. First, the analysis uses only the Scopus database for bibliometric analysis. While Scopus is a reliable source, incorporating other databases such as Web of Science or Google Scholar in future research could help capture studies not covered in this paper and provide more comprehensive insights. Additionally, this study does not include gray literature or regional journals. Future research could address these areas, as neuroQuran studies are still a niche field.

Secondly, this study was limited to publications written in English. Future research should aim to include publications in other languages to ensure broader and more comprehensive findings.

Finally, this study used bibliometric techniques to analyze the metadata obtained from the database. Bibliometric techniques have the advantage of allowing quantitative analysis of metadata. However, analysis of publication content is limited to article keywords and not article content. Further research could use an approach such as a systematic literature review to explore the content of the articles in a more qualitative and in-depth manner. Nevertheless, this paper was able to present the major findings and limitations of some of the selected journal articles from 2019 to 2023, and to identify trends and existing gaps in neuroQuran research.

Conclusion and Future Work

This study reviewed neuroQuran research that used neuroimaging modalities from 2009 to 2023. The review found that the EEG is the most common method used in neuroQuran research for the years 2019 to 2023. A bibliometric analysis of academic publications was used to identify global research trends in neuroQuran research, such as the most-cited article and journal.

To critically assess the trend in neuroQuran research, an analysis of journal articles published in the five years 2019–2023 was completed. Nine selected journal articles were chosen and summarized for their major contributions and limitations. The findings suggest that synthesizing past research, even with certain limitations, is instrumental in shaping future trends and filling gaps in neuroQuran research. It is recommended that future neuroQuran research incorporate recent neurotechnological devices such as MEG or utilize simultaneous recording of neuroimaging modalities such as EEG-fMRI or MEG-EEG to improve spatial resolution, sensitivity and accuracy of neuronal source detection, and to complement the findings for each modality.

To uncover more applications of neuroimaging modalities, future studies could examine the effects of using the Holy Quran as a complementary therapy in the fields of mental health and neuroplasticity, in addition to conducting longitudinal studies. Furthermore, combining neuroimaging modalities with Artificial Intelligence (AI) introduces a new interdisciplinary dimension, suggesting the potential for more sophisticated data analysis, prediction models, and novel theoretical insights in neuroQuran research.

Acknowledgments

The authors acknowledged Universiti Malaysia Sarawak for supporting this project.

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