ORIGINAL ARTICLE

The effect of listening to Holy Quran recitation on stress among healthy adults: a non-blinded randomized controlled trial

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ABSTRACT

BACKGROUND

Stress is the body's inability to reach a balance between physical or psychological demands and the ability to meet them. Failure to meet these demands has a crucial impact which includes physical, emotional, and behavioral disorders. Recitation of the Quran is believed to cause relaxation by lowering adrenocorticotropic and cortisol hormonal levels. This study aimed to assess the effects of Quran recitation on stress levels using the biofeedback indicators electromyogram, skin conductance, and heart rate among healthy adults.

METHODS

This study used a pre- and post-test group design involving 40 males between 19 and 23 years of age, randomized into two groups, i.e. control group (n=20) and Quran recitation listeners (n=20). The subjects were conditioned in a quiet room for 30 minutes before the stress level measurements were taken. The stress level measurements by means of electromyogram, skin conductance, and heart rate were performed with biofeedback before and after giving the stressor tests' protocol. Statistical analysis using independent t-test was then performed.

RESULTS

The baseline comparative measurement using biofeedback between control and treatment groups revealed nonsignificant between-group differences in electromyogram, skin conductance, and heart rate (p=0.150; p= 0.389; and p=0.985 respectively). After applying the stress protocol followed by the intervention, the independent t-test revealed significant between-group differences in electromyogram and skin conductance (p= 0.042 and p=0.030), but not in heart rate (p=0.741).

CONCLUSIONS

Our study demonstrated that Quran recitation has a significant effect in relieving stress levels assessed using biofeedback parameters (electromyogram and skin conductance) among healthy adults.

Keywords: Biofeedback, electromyogram, heart rate, Quran, skin conductance, stress, healthy adults

INTRODUCTION

The biological, psychological, and social aspects of humans are the three components required to create a fully healthy human being.[1] Along with the more complex needs of humans, such as food, education, and jobs, and amidst the tight competition to fulfill these needs, humans more easily get stressed. Stress is an adaptive individual response to various external pressures or demands. If the individuals can adapt to stress, then they are in a eustress condition. Meanwhile, a distress condition can cause physical, emotional, or behavioral disorders.[2] When one receives a stressor, the body will institute an adaptation mechanism to the stress which only succeeds when the stressor is mild or transient, but not when the stressor is too great or prolonged. The general adaptation syndrome (GAS) is a process that produces the physiological changes during stress and is regulated by the hypothalamus. [3] When the brain is stimulated by a physical or psychological stressor, the hypothalamus, in receiving this stimulation, will activate the sympathetic nervous system, producing corticotropin-releasing hormone (CRH) to trigger the secretion of adrenocorticotropic hormone (ACTH) and cortisol, and the release of vasopressin.[4] Additional management is needed in extreme or prolonged stressor conditions. Appropriate and cost-effective management can alleviate the stress.[5]

Individuals exposed to acute or chronic stress or distress conditions usually respond well to non-pharmacological therapy, along with psychiatric interviews or supportive reinforcements from family or close friends.[6] This is the basis of the development of relaxation therapy in individuals exposed to stress or distress conditions. Quran recitation and classical music are two things that have been proven to cause relaxation.[7] Regarding the correlation between Quran recitation and mental health, it was revealed that listening to Quran recitation had various positive effects on the body, such as increasing mental health status and strengthening positive emotions and psychological comfort.[8] Besides, Quran recitation has no negative influence in its application to patients in the intensive care unit (ICU) at the weaning period from the ventilator through vital sign assessment.[9] Furthermore, Quran recitation can increase the left and right brainwave activities, especially the alpha waves, by up to 12.67%, higher than classical music which produces 9.96% alpha waves.[7]

The measurement of stress in various studies uses multiple modalities. Stress levels may be measured using a perceived stress scale.[8] Cortisol levels in the epidermis may also be used as an indicator although the study in question was limited to experimental animals.[9] The development of stress is measured through objective indicators that can be assessed by biofeedback which captures the body's stress response.[10] A scoping review investigated the effect of listening to Holy Quran recitation on anxiety, stress, and depression, showing that Quran recitation and listening can be applied as a useful nonpharmacological treatment to reduce anxiety, stress, and depression.[11] A meta-analysis showed that heart rate variability (HRV) biofeedback is associated with a reduction in self-reported depression.[12] Biofeedback has principally been used in the medical realm, although there is also a long-standing tradition of research on biofeedback techniques for mental disorders.[13,14] Electromyographic biofeedback (EMGB), skin conductance biofeedback, or heart rate variability biofeedback (HRVB) are three of the most used peripheral responses, while electroencephalographic (EEG) and functional magnetic resonance imaging neurofeedback (fMRI-NF) are two of the most common techniques using neural activity. [14]

The difference between our study and previous studies lies in the fact that we used biofeedback to assess the reduction in stress levels. This study aimed to evaluate the effect of Quran recitation on stress levels using biofeedback indicators (electromyogram, skin conductance, and heart rate) among healthy adults.

METHODS

Research design

This study used a non-blinded randomized control trial. The study was performed in the psychiatry clinic of a teaching hospital from November to December 2019. The data was collected at 3 pm – 5 pm on a daily basis.

Research subjects

The population of this study were male undergraduate students, who were recruited according to the following criteria: age 18 to 25 years, not having hearing loss or neurological deficits, and not under treatment for chronic

disease. This study did not use the female undergraduate student population to avoid bias of psychological changes related to menstrual cycle. The minimum sample size was calculated with the Lemeshow formula by setting the level of confidence (α=95%) and desired power (β=80%) in comparing two means of heart rate with an effect size of 0.80. The optimal sample size was found to be 20 per group. A total of 40 males who met the inclusion criteria were assigned as research subjects after agreeing to sign informed consent to listen to Quran recitation.

To confirm that all subjects began the stress test with homogeneous psychological and stress conditions, each subject was provided with food to obtain an optimum endorphin level before being tested. Besides, each subject was also given the same accommodation on the study location, homogeneous sensor equipment, and a lighting condition in accordance with the protocol on dark conditions. The subjects were also conditioned to be in a relaxed position at the start of the study and were given information regarding the protocol.

Intervention

The subjects were randomized into two groups i.e the control group (n= 20) and the Quran recitation listener group (n= 20). The examination room was quiet with the air at room temperature. Every subject was measured for almost two hours including 30 minutes of adaptation, 15 minutes of baseline measurement, a break of 30 minutes, and then 10 minutes of applying stress induction. The protocol continued with 10 minutes of intervention for the Quran recitation group and staying quiet for the control group. Lastly, measurements of electromyogram, skin conductance, and heart rate were conducted for 15 minutes. The intervention consisted of listening to Quran recitation of *Surah Ar-Rahman* using an MP3 player which produced an intensity of around 77.35 dB as measured by the sound-meter from the android application Physics Toolbox Suite version 1.9.3.6. The MP3 player was placed on a desk with minimal risk of falling and was directed toward the hearing center of the subject within 1 meter. The study flowchart is presented in Figure 1.

Data collection

The dependent variables used in this study were electromyogram (EMG), skin conductance (SC), and heart rate (HR), measured by means of the NeXus-10 Mark II biofeedback system, version 1.02. To ensure that stress induction has had an effect, a comparison was made of EMG, SC, HR measurements after stress induction with baseline measurements in all subjects. The electromyogram is the result of measurement to assess the activity of the muscles and of the motor neurons (the nerve cells that control the muscles). The EMG is expressed in millivolts, and a higher millivolt value indicates higher activity of the muscles, in the form of muscular contraction. Skin conductance is measured in micro-siemens and is the measurement of the electrical conductivity of the skin. Skin conductance reflects the level of psychological or physiological arousal, elicited by cognition or emotions. Therefore, a higher micro-siemens value of skin conductance indicates that a higher state of stress is present. Skin conductance is measured with two electrodes preferably on the fingers, and the heart rate is measured in beats per minute. The tools used in this study fulfilled the requirements of the European Community Council Directive 93/42/EEC for medical equipment.

Statistical analysis

The observations were tested with the independent t-test. The electromyogram (EMG), skin conductance (SC), and heart rate (HR) from each baseline, stressor, and intervention session resulted in normally distributed data. Therefore, the analysis was continued with a parametric test (independent t-test) to access the stress effect after stress induction to compare EMG, SC, and HR between baseline and post-stress induction measurements in all subjects. Then, determination of the differences in EMG, SC, and HR between the control and Quran recitation groups was conducted by using the independent t-test.

Ethical clearance

Approval for this study was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret with protocol reference number 212/UN27.06/KEPK/2019. All patient identifiers were hidden to ensure patient anonymity. Consent from the Universitas Sebelas Maret Teaching Hospital Director had been obtained through a letter of permission.

RESULTS

A total of 40 male subjects took part in the entire process starting from the adaptation stage, baseline examination, up to the post-stress induction examination, with 20 subjects in the

intervention group listening to the Quran *Surah Ar-Rahman* recitation. The means of the EMG, SC and HR parameter assessments in the baseline session and stress-induced/relaxation session are shown in Tables 1 and 2.
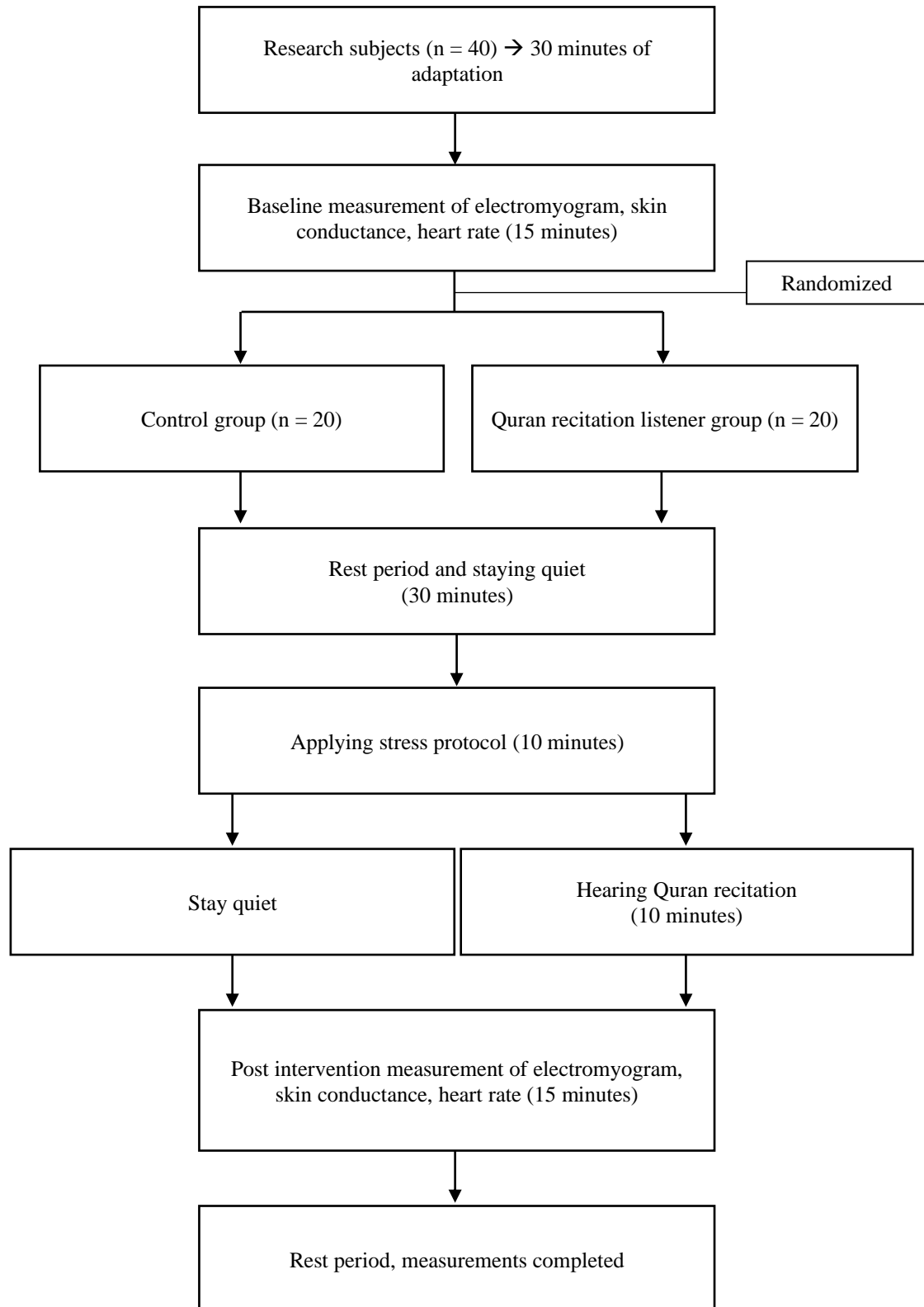
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│ Research subjects (n = 40) → 30       │
│ minutes of adaptation                 │
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                 │
                 ▼
┌──────────────────────────────────────┐
│ Baseline measurement of               │
│ electromyogram, skin conductance,     │
│ heart rate (15 minutes)               │
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                 │──────────────┐  ┌──────────────┐
                 │              └──│  Randomized  │
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┌───────────────┐  ┌─────────────────────────┐
│ Control group │  │ Quran recitation         │
│ (n = 20)      │  │ listener group (n = 20)  │
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        │                 │
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│ Rest period and staying quiet         │
│ (30 minutes)                          │
└──────────────────────────────────────┘
                 │
                 ▼
┌──────────────────────────────────────┐
│ Applying stress protocol (10 minutes) │
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        ▼                 ▼
┌───────────────┐  ┌─────────────────────────┐
│ Stay quiet    │  │ Hearing Quran recitation │
│               │  │ (10 minutes)             │
└───────────────┘  └─────────────────────────┘
        │                 │
        └────────┬────────┘
                 ▼
┌──────────────────────────────────────┐
│ Post intervention measurement of      │
│ electromyogram, skin conductance,     │
│ heart rate (15 minutes)               │
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                 │
                 ▼
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│ Rest period, measurements completed   │
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Figure 1. Flow chart of the participants

Table 1. Comparison of stress response (EMG, SC, and HR parameters)
between the control and intervention group at base-line

Characteristics	Quran recitation group (n=20)	Control group (n=20)	p value
Age (years)	21.85 ± 1.38	21.71± 1.34	0.751
EMG (millivolt)	41.26 ± 15.20	53.21 ± 13.02	0.150
SC (micro-siemens)	9.11 ± 4.17	12.65 ± 6.18	0.389
HR (beat per minute)	76.13 ± 10.80	76.06 ± 14.53	0.985

Note: Data expressed as mean ± standard deviation.
EMG: electromyogram; SC: skin conductance; HR: heart rate

Table 2. Comparison of stress response (EMG, SC, and HR parameters)
between the control and intervention groups after the intervention

Characteristics	Quran recitation group (n=20)	Control group (n=20)	p value
EMG (millivolt)	43.43 ± 19.10	57.58 ± 17.01	0.042
SC (micro-siemens)	8.07 ± 4.15	12.18 ± 6.34	0.030
HR (beats per minute)	75.05 ± 10.71	76.04 ± 12.71	0.741

Note: Data expressed as mean ± standard deviation.
EMG: electromyogram; SC: skin conductance; HR: heart rate

The baseline data of each of the three parameters EMG, SC, and HR showed no significant differences between Quran recitation and control groups, as shown in Table 1. The Shapiro-Wilk normality test showed that the data was normally distributed with p>0.05. Parametric independent t-test was then carried out to compare the three stress parameters between the intervention group and the control group.

After the intervention, the independent t-test on EMG and SC parameters between the Quran group and control group showed significant differences (p=0.042 and p=0.031, respectively). However, regarding the HR parameter, there was no significant difference between the Quran recitation and control groups (p=0.741) (Table 2).

DISCUSSION

Intergroup comparison was only performed on variables which showed significant differences in the independent t-test, namely EMG and SC. The EMG variable showed a significant difference in Quran recitation after the intervention, which showed that stressor administration affected muscle activity. [15]

The working principle of EMG is to measure the muscle action potential, because muscle activity will give rise to action potentials, due to intramuscular chemical reactions. In EMG examination, the difficulty of isolating single muscle cells causes electrical activity to be recorded from several muscle fibers. The electrical signals of a muscle or group of muscles are taken in the form of waves of varying amplitude, based on the level of muscle activity. Recording EMG signals requires a conductor/electrode to send muscle action potential signals to the electromyograph. The greater the muscle activity, the greater the action potential measured in millivolts that is produced on EMG examination.

Research explaining the influence of listening to Quran recitation had been carried out previously and the results showed that listening to Quran recitation has a positive impact in various settings. What makes the difference was how to assess the resulting impacts after listening to the Quran recitation. Some studies had chosen to use laboratory parameters to assess reduced anxiety with reduced adrenocorticotropic hormone (ACTH) and cortisol levels by listening to Quran recitation. [16]

Some studies chose to carry out measurements using electroencephalography. In the research findings, listening to Quran recitation increased the alpha band even more than listening to classical music. The implication was that listening to the Quran in particular could result in a more relaxing and alert condition compared to classical music based on electroencephalographic examination. [7]

Another study attempted to prove the effect of listening to Quran recitation on patients placed on ventilators in the intensive care unit. The results of the study showed that patients who had listened to the Quran and were weaned from the ventilator, experienced a positive effect on the parameters of

rapid shallow breathing index, respiratory rate, heart rate, oxygen saturation, exhaled carbon dioxide, and blood pressure, although statistically the effect was not significantly different from the controls.[9]

Based on the abovementioned studies, the present researchers were trying to explore biofeedback which measured heart rate, skin conductance, and electromyography which had not been widely done. This method was used to describe the post-stress biological response to the intervention of listening to Quran recitation, which were in line with those of several previous studies.

Measuring the mean SC value in the Quran recitation and control groups produced a significant difference. The results indicated that the mean SC value in the Quran recitation group and the control group provided a stress response and adaptive autonomic function resulting in a clearer decrease in SC value of the Quran group. This is in accordance with studies stating that listening to Quran recitation can improve mental health status by strengthening positive emotions and psychological comfort and even change negative emotions.[17]

Skin conductance is assessed by utilizing a galvanic skin response (GSR) sensor, that can sense and measure different levels of skin conductivity as determined by skin moisture level and sweat salt content on the skin surface. The sweat produced by the sweat glands is influenced by the sympathetic nerves. Thus, stress affects the sweat glands on the surface of the skin to secrete sweat and increase the level of skin conductivity measured in micro-siemens.[7] Changes in a person's emotional level affects the sweat glands to secrete sweat, thereby increasing the level of skin conductivity.[18]

The HR parameter showed non-significant differences between the two groups, although the mean of the Quran group was lower than that of the control group. Heart rate is produced by changes in heart beat frequency which has high sensitivity to adapt to small changes in the body. The ideal average heart rate is measured within 24 hours using a monitor placed on the left side of the chest then following the mobility of the examined subject. Thus, heart rate variability can be assessed. Although there are many reports regarding heart rate, this parameter had also been used as an indicator of mental fatigue and effort expenditure to accomplish some targeted objectives.[19]

Some studies showed that listening to Quran recitations has various positive effects on the body, such as reducing depression and stress. The sound of Quran recitation has a positive effect on stress and anxiety in patients treated in the intensive care unit (ICU). Listening to the Quran is known to have the effect of increasing brain activity, especially alpha waves.[20] Listening to Quran recitations could also improve a person's mental health status through strengthened positive emotions and psychological comfort, and even change negative emotions into positive ones.[21]

Several factors that in the light of the limitations caused the obtained data to be less representative or to be biased, included the room temperature of being too low or too high which affected the SC and HR values. Uncontrolled body movements during data collection and also the cough reflex could affect the EMG value. Another subject condition that influenced the results during data collection was drowsiness which caused the subjects to be out of focus and finally affected HR.[22] In future studies, level of the room temperature should be measured. Quran recitation and listening can be applied as a useful nonpharmacological treatment to reduce stress.

CONCLUSION

This study demonstrated that recitation of the Quran has a notable positive influence on the stress level among healthy adults. This process not only promotes mental health but also contributes to the holistic well-being of the body and the preservation of the soul.

collection, drafting and critical revision of the article. AR was responsible for data collection, designing tables, and drafting the article. NW and DKM supervised the project, contributed to the design and implementation of the research, to critical review of the manuscript, approved the final article version, and supported data collection.

Funding

Data Availability Statement

Derived data supporting findings of this study are available from the corresponding author by formal request.

Declaration of Use of AI in Scientific Writing

Nothing to declare.

REFERENCES

1. Zamanzadeh V, Jasemi M, Valizadeh L, Keogh B, Taleghani F. Effective factors in providing holistic care: a qualitative study. Indian J Palliat Care 2015;21:214-24. doi: 10.4103/0973-1075.156506. 6.

2. Slavich GM. Life stress and health: a review of conceptual issues and recent findings. Teach Psychol 2016;43:346-55. doi: 10.1177/0098628316662768.

3. Buckner SL, Mouser JG, Dankel SJ, Jessee MB, Mattocks KT, Loenneke JP. The general adaptation syndrome: potential misapplications to resistance exercise. J Sci Med Sport 2017;20:1015-7. https://doi.org/10.1016/j.jsams.2017.02.012S.

4. Allen MJ, Sharma S. Physiology, adrenocorticotropic hormone (ACTH). In: StatPearls Treasure Island (FL): StatPearls Publishing; 2023.

5. Boelen PA, Giannopoulou I, Papadatou D. Patterns and predictive value of acute prolonged grief and posttraumatic stress in youngsters confronted with traumatic loss: a latent class analysis. Psychiatr Res 2023;319:114961. doi: 10.1016/j.psychres.2022.114961.

6. Světlák M, Malatincova T, Halamkova J, et al. The effectiveness of three mobile-based psychological interventions in reducing psychological distress and preventing stress-related changes in the psycho-neuro-endocrine-immune network in breast cancer survivors: study protocol for a randomised controlled trial. Internet Interventions 2023;32:100628. doi: 10.1016/j.invent.2023.100628.

7. Zulkurnaini NA, Kadir RSSA, Murat ZH, Isa RM. The comparison between listening to Al-Quran and listening to classical music on the brainwave signal for the alpha band. In: Third International Conference on Intelligent Systems Modelling and Simulation,2012. Kota Kinabalu, Malaysia: IEEE, Feb. 2012, pp. 181–6. doi: 10.1109/ISMS.2012.60.

8. Mahjoob M, Nejati J, Hosseini A, Bakhshani NM. The effect of holy Quran voice on mental health. J Relig Health 2016;55:38-42. doi: 10.1007/s10943-014-9821-7.

9. Yadak M, Ansari KA, Qutub H, et al. The effect of listening to Holy Quran recitation on weaning patients receiving mechanical ventilation in the intensive care unit: a pilot study. J Relig Health 2019;58:64-73. doi: 10.1007/s10943-017-0500-3.

10. Dehghani A, Soltanian-Zadeh H, Hossein-Zadeh GA. Neural modulation enhancement using connectivity-based EEG neurofeedback with simultaneous fMRI for emotion regulation. NeuroImage 2023;279:120320. doi: 10.1016/j.neuroimage.2023.120320.

11. Moulaei K, Haghdoost AA, Bahaadinbeigy K, Dinari F. The effect of the holy Quran recitation and listening on anxiety, stress, and depression: a scoping review on outcomes. Health Sci Rep 2023;6:e1751. doi: 10.1002/hsr2.1751.

12. Fernández-Alvarez J, Grassi M, Colombo D, et al. Efficacy of bio- and neurofeedback for depression: a meta-analysis. Psychol Med 2022;52:201-16. doi: 10.1017/S0033291721004396.

13. Lehrer PM, Gevirtz R. Heart rate variability biofeedback: how and why does it work? Front Psychol 2014;5:756. doi: 10.3389/fpsyg.2014.00756.

14. Sacchet MD, Gotlib IH. Neurofeedback training for major depressive disorder: recent developments and future directions. Expert Rev Neurotherapeutics 2016;16:1003-5. doi: 10.1080/14737175.2016.1199959.

15. Luijcks R, Hermens HJ, Bodar L, Vossen CJ, Van Os J, Lousberg R. Experimentally induced stress validated by EMG activity. PLoS One 2014;9: e95215. doi: 10.1371/journal.pone.0095215.

16. Aghamohamadi M, Hanachi P. The effect of voice of the Holy Quran on cortisol, ACTH and psychological factors during one maximal exercise in young female athletes. J Adv Med Biomed Res 2014;22:110–8.

17. Darabinia M, Gorji AMH, Afzali MA. The effect of the Quran recitation on mental health of the Iranian medical staff. J Nurs Educ Pract 2017;7:30-6. doi: 10.5430/jnep.v7n11p30.

18. Nagai Y, Jones CI, Sen A. Galvanic skin response (GSR)/electrodermal/skin conductance biofeedback on epilepsy: a systematic review and

meta-analysis. Front Neurol 2019;10:377. doi: 10.3389/fneur.2019.00377.

19. Csathó A, Van Der Linden D, Matuz A. Change in heart rate variability with increasing time-on-task as a marker for mental fatigue: a systematic review. Biol Psychol 2024;185:108727. doi: 10.1016/j.biopsycho.2023.108727.

20. Syaifulloh MK, Hanafi M, Ardyanto TD, Wiyono N, Budianto P, Jumiatmoko J. Electroencephalography (EEG) frontal alpha asymmetry index as an indicator of children's emotions in the three Quran learning methods: visual, auditory, and memory. Iranian J Psychiatry 2023; 18:93-6, doi: 10.18502/ijps.v18i1.11417.

21. Al-Galal SAY, Alshaikhli IFT, Bin Abdul Rahman AW, Dzulkifli MA. EEG-based emotion recognition while listening to Quran recitation compared with relaxing music using valence-arousal model. In: 4th International Conference on Advanced Computer Science Applications and Technologies (ACSAT), Kuala Lumpur: IEEE, Dec. 2015, pp. 245–250. doi: 10.1109/ACSAT.2015.10.

22. Alfiah N, Meiza A, Hidayat IN. Reducing stress on students through traditional music. In: Proceedings of 1st Workshop on Environmental Science, Society, and Technology, WESTECH 2018, December 8th, 2018, Medan, Indonesia: EAI, 2019. doi: 10.4108/eai.8-12-2018.2283928.