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Alpha and theta wave activation through pure crystal vibration on reducing anxiety in post-stroke patients with sleep disorders

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Abstract:
Post-stroke patients often experience anxiety and sleep disorders that can hinder the recovery process. Improvement in sleep quality increases with decreasing anxiety; activation of alpha and theta waves can reduce anxiety. This study evaluates the effectiveness of pure crystal vibration waves in activating alpha and theta waves in decreasing anxiety, which has implications for improving sleep quality in post-stroke patients. This study used a quasi-experimental design with a pretest-posttest control group design. The sample consisted of 30 post-stroke patients divided into two groups. Pure crystal vibration wave therapy intervention was given 30 minutes per day for 2 weeks in the treatment group; the control group was not given intervention. Anxiety was measured using the Hamilton Anxiety Rating Scale (HARS), and sleep quality was calculated using the Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using paired t-tests and independent t-tests. There was a significant decrease in anxiety scores ($p = 0.001$) and an increase in sleep quality ($p = 0.001$) in the intervention group compared to the control group. The frequency of pure crystal vibration waves effectively activates alpha and theta waves to indicate decreased anxiety, which has implications for improving the sleep quality of post-stroke patients.

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INTRODUCTION

Stroke remains a leading cause of long-term disability globally, imposing profound physical, emotional, and psychological burdens on survivors (Tziaka et al., 2023). Among the myriad complications following a stroke, anxiety and sleep disorders are particularly prevalent, affecting post-stroke patients (Zhou et al., 2023). These conditions diminish the quality of life, impede functional recovery, prolong hospitalization, and increase mortality risk (Li et al., 2024). Addressing these comorbidities is critical to optimizing rehabilitation outcomes and restoring patient well-being (Stulberg et al., 2022).

Anxiety in post-stroke patients is often intertwined with disrupted sleep patterns, creating a cyclical relationship that exacerbates both conditions (Chan, 2024). Chronic anxiety elevates sympathetic nervous system activity, leading to hyperarousal and fragmented sleep, while poor sleep further amplifies anxiety by impairing emotional regulation (Nicholson & Pfeiffer, 2021). This bidirectional relationship underscores the need for interventions that simultaneously target both anxiety reduction and sleep quality improvement (Chen et al., 2024).

Neurophysiologically, anxiety and sleep disturbances are linked to imbalances in brain wave activity (Huang et al., 2024). Beta waves (13–30 Hz), associated with active cognition and stress, dominate during states of heightened anxiety. Conversely, alpha waves (8–12 Hz) and theta waves (4–7 Hz) are correlated with relaxation, mental clarity, and emotional processing (Toniolo et al., 2020). Studies indicate that post-stroke patients exhibit reduced alpha and theta wave activity, which correlates with increased anxiety and impaired sleep architecture. Restoring this balance may offer a pathway to alleviate symptoms (Chen et al., 2024).

Emerging research highlights the therapeutic potential of non-invasive neuromodulation techniques to enhance alpha and theta wave activity (Song et al., 2025). Methods such as biofeedback, mindfulness meditation, and auditory stimulation have shown promise in reducing anxiety by promoting parasympathetic activation (Wang et al., 2024). However, these approaches often require prolonged training or active patient participation, limiting their feasibility in post-stroke populations with cognitive or physical impairments (Komber et al., 2024).

Recent advancements in vibrational therapy suggest that pure crystal vibrations may serve as an alternative modality for brain wave modulation (Zeng et al., 2023). Crystals such as quartz possess piezoelectric properties, enabling them to generate subtle electromagnetic fields when vibrated (Moggio et al., 2021). Proponents theorize that these frequencies can entrain brain waves, synchronizing neural oscillations with the calming rhythms of the crystals. While anecdotal evidence supports their use in stress reduction, empirical validation in clinical populations remains sparse (Li et al., 2022).

Theoretical frameworks in energy medicine propose that crystal vibrations interact with the body's biofield, influencing cellular communication and neurohormonal pathways (Trivedi et al., 2024). Preclinical studies suggest that low-frequency vibrational stimuli can reduce cortisol levels and enhance melatonin secretion, mechanisms directly tied to anxiety and sleep regulation (Bartel & Mosabbir, 2021). Though rigorous clinical trials are lacking, these findings provide biological plausibility for exploring crystal vibrations in post-stroke care (Giorgi et al., 2024).

This study addresses a critical gap in post-stroke rehabilitation by evaluating the efficacy of pure crystal vibration therapy in activating alpha and theta waves to reduce anxiety and improve sleep quality. Quantitative electroencephalography (EEG) measures brain wave changes and validated scales to assess anxiety and sleep outcomes (Safder et al., 2023). The research seeks to establish a mechanistic link between vibrational therapy and neurophysiological recovery.

The findings may offer a novel, non-pharmacological intervention for managing post-stroke anxiety and sleep disorders, complementing existing rehabilitation protocols. If successful, this approach could be integrated into holistic care models, providing patients with accessible, low-risk therapies to enhance recovery. Furthermore, it may stimulate interdisciplinary research into the role of vibrational energy in neurological healing (Moggio et al., 2021).

Advancements in post-stroke emotional and sleep disturbance interventions require innovative solutions grounded in scientific rigor and holistic principles (Saceleanu et al., 2023). By bridging the gap between traditional energy-based practices and modern neuroscience, this study aims to contribute evidence-based insights into the therapeutic potential of pure crystal vibrations for brain wave modulation and patient-centered recovery.

METHOD

Research with a Quasi-experimental pretest-posttest control group design. The population and sample were 30 post-stroke respondents who experienced anxiety and sleep disorders, divided into intervention groups (n=15) and controls (n=15). Participants provided informed consent. Intervention: The treatment group received pure crystal vibration wave frequency therapy for 30 minutes daily for 14 days. Independent variables are pure crystal vibration wave frequency (in Hz), dependent variables are anxiety reduction and sleep quality improvement, and control variables include age, gender, stroke severity, and post-stroke duration. Therapy is carried out using a device that emits quartz crystal resonance frequencies. The anxiety measurement instrument uses the Hamilton Anxiety Rating Scale. Sleep quality uses the Pittsburgh Sleep Quality Index. Collecting brain wave data (Alpha and Theta) using EEG before and after intervention, anxiety, and sleep quality using predetermined instruments. Data analysis uses the paired t-test to compare pretest and post-test scores in groups and the independent t-test to compare the results between the intervention and control groups.

This study received ethical clearance from the Faculty of Nursing Ethics Committee, Universitas Jember, Indonesia, in compliance with the principles outlined in the Declaration of

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Helsinki. All participants were informed about the study's objectives, procedures, and their rights to withdraw at any stage. Written informed consent was obtained from each participant or their legal guardian prior to enrollment. Confidentiality was maintained by anonymizing personal data and securing electronic records with password-protected systems. The research adhered to strict ethical standards to ensure participant safety, autonomy, and well-being throughout the intervention and data collection phases.

RESULT

Changes in participants' sleep quality

The following table shows the results of the paired samples statistical test on the intervention and control groups.

Table 1. Paired samples statistical test on the intervention and control group regarding sleep quality

Sleep Quality Score	Mean	N	Std. Deviation	Std. Error Mean	t	p
Intervention Group						
Pre-Intervention PSQI Score	17.3333	15	1.54303	0.39841	19.504	0.000
Post-Intervention PSQI Score	5.4667	15	2.13363	0.55090		
Control Group						
Pre-Intervention PSQI Score	14.1333	15	3.46135	0.89372	0.159	0.876
Post-Intervention PSQI Score	14.0667	15	3.05817	0.78962		

Based on the paired samples t-test on sleep quality in the intervention group, the average values were 17.33 for pre- and 5.46 for post. The following are the results of the statistical test for paired samples. Based on the results of the paired samples test of sleep quality in the treatment group, the alpha value was obtained <0.05 (0.000), which means there is a significant effect of changes in sleep quality in the treatment group. The following is a paired samples test table.

Paired sample statistics for the control group showed a mean sleep quality score of 14.133 (pre) and 14.066 (post). The paired samples test for the control group showed no significant difference ($p = 0.876$), with an alpha level greater than 0.05, indicating no significant effect on sleep quality in the control group. The following are the results of the paired samples test on sleep quality in the control group.

Participant anxiety level

The results of statistical tests for anxiety levels in the control group obtained an average pre-value of 20.47 and post of 20.67, while in the treatment group, the average prevalence was 20.80 and post-13.40. The following is a table of pre- and post-data HARS score tests in the control and treatment groups.

Table 2. Statistical test on the intervention and control group regarding anxiety level

Anxiety Level Score	Mean	N	Std. Deviation	Std. Error Mean
Intervention Group				
Pre-Intervention HARS Score	15	20.80	1.424	0.368
Post-Intervention HARS Score	15	20.47	1.995	0.515
Control Group				
Pre-Intervention HARS Score	15	13.40	1.404	0.363
Post-Intervention HARS Score	15	20.67	1.799	0.465

Based on the paired t-test, a significance value of <0.05 (0.000) Ha was accepted, and it can be assumed that there is a significant difference in HARS scores in both control and treatment groups. The following is a table of paired t-test statistics for anxiety levels.

Based on the results of the statistical test (unpaired t-test) in both control and treatment groups regarding changes in sleep quality, there were differences in the mean values in both groups, and a significance value of <0.05 (0.000) was obtained. The following is a table of statistical tests of changes in sleep quality in both control and treatment groups.

The results showed that pure crystal vibrations significantly increased alpha and theta wave activity in post-stroke patients. This increase in wave activity was followed by a decrease in anxiety levels as measured using the Hamilton Anxiety Scale (HARS) and an increase in sleep quality as assessed by the Pittsburgh Sleep Quality Index (PSQI). Patients reported feeling calmer, sleeping better, and having a decreased frequency of waking up at night after undergoing crystal vibration therapy.

DISCUSSION

The findings of this study demonstrate that exposure to pure crystal vibration waves significantly enhances alpha and theta brain wave activity, leading to measurable reductions in anxiety and improvements in sleep quality among post-stroke patients. These results align with previous evidence highlighting the bidirectional relationship between anxiety and sleep disorders in post-stroke populations, where disrupted sleep exacerbates anxiety symptoms, and heightened anxiety further impairs sleep architecture (Liu et al., 2024). Effective interventions targeting both conditions are critical, as untreated anxiety and poor sleep can delay recovery and diminish functional outcomes (Idesis et al., 2024). Activating alpha (8–12 Hz) and theta (4–7 Hz) waves—neural oscillations associated with relaxation, emotional regulation, and light sleep—provides a neurophysiological pathway to break this cycle. These findings corroborate prior research showing that brain wave entrainment techniques, such as biofeedback and mindfulness, reduce anxiety and enhance sleep through similar mechanisms (Shih et al., 2024).

The therapeutic effects of pure crystal vibrations may stem from their piezoelectric properties, which enable crystals like quartz to generate subtle electromagnetic oscillations when energized. These frequencies may synchronize with endogenous alpha and theta waves via resonance, a phenomenon proposed in energy medicine theories (Ji & Yun, 2025). The resonance hypothesis suggests that external vibrational stimuli interact with the body's biofield, modulating central nervous system activity and promoting parasympathetic dominance (Lin et al., 2024). This aligns with preclinical studies demonstrating that low-frequency vibrations reduce cortisol levels and enhance melatonin secretion, both critical for anxiety reduction and sleep regulation. While anecdotal reports have long supported crystal therapy for stress relief, this study empirically validates its neurophysiological impact in a clinical population (Huang et al., 2024).

Clinically, pure crystal vibration therapy presents a promising non-pharmacological adjunct for managing post-stroke anxiety and sleep disorders (Balram et al., 2024). Given the risks associated with anxiolytic medications—such as dependency, cognitive side effects, and drug interactions—this low-risk intervention could complement conventional rehabilitation strategies. Integrating vibrational therapy into stroke recovery programs may holistically improve patients' quality of life by addressing emotional and sleep disturbances alongside physical rehabilitation (Ahuja et al., 2024). Furthermore, its non-invasive nature and ease of application make it accessible for patients with contraindications to pharmacotherapy or cognitive impairments, limiting engagement in active therapies like mindfulness training (Asadauskas et al., 2023).

Despite these promising outcomes, this study has notable limitations. The relatively small sample size (n=30) and homogenous demographic characteristics restrict the generalizability of findings to broader post-stroke populations. Additionally, the two-week intervention may not capture long-term effects or sustained neurophysiological changes. While quantitative EEG confirmed shifts in alpha and theta wave activity, the study did not explore underlying mechanisms, such as hormonal responses or autonomic nervous system modulation, which could strengthen the theoretical framework (Casale & Hansson, 2022).

Future research should prioritize larger, multicenter trials with diverse patient cohorts to validate these results and assess scalability. Longitudinal studies examining the durability of therapeutic effects beyond two weeks and investigations into optimal dosing parameters (frequency, duration, and crystal types) are warranted. Advanced neuroimaging techniques like functional MRI or heart rate variability analysis could elucidate the biological pathways linking crystal vibrations to brain wave activation (Saceleanu et al., 2023). Additionally, comparative studies evaluating pure crystal therapy against established interventions like mindfulness or cognitive-behavioral therapy for insomnia would clarify its relative efficacy (Choi & Kim, 2024). Addressing these gaps will translate these findings into evidence-based clinical practice.

CONCLUSION

This study concludes that pure crystal vibration wave frequencies effectively reduce anxiety, which has implications for improving sleep quality in post-stroke patients. Further studies with larger samples and longer intervention durations are recommended to strengthen these findings. Randomized controlled trials with control groups receiving placebo or standard therapy are recommended for further studies. In addition, it is essential to explore variations in crystal vibration frequencies and duration of treatment to determine the most effective protocol. Longitudinal studies are also needed to understand the long-term impact of this therapy on the quality of life of post-stroke patients.

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