Neurocognitive and Psychological Effects of OM Chanting in Alzheimer's Disease: A Systematic Investigation

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Abstract*—Among the principal findings of this study, the theta/beta ratio improved by 85.4%, indicating enhancement in relaxation and emotional regulation. Alzheimer's Disease affects over 55 million individuals globally, leading to memory loss and disruption of identity. Currently available pharmacological treatments provide limited symptomatic relief, highlighting the potential need for additional therapeutic strategies. This study systematically investigates the neurocognitive and psychological effects of OM chanting, an ancient meditative practice, in a cohort of 120 participants in Bangalore, India, including 25 individuals diagnosed with Alzheimer's Disease. The study did not include a control or sham group; therefore, the findings should be interpreted with caution regarding causal relationships. Electroencephalography (EEG) was used to assess changes in brainwave activity following daily OM chanting sessions of 15-20 minutes over four weeks. Results indicated neurophysiological changes, including a 34.2% increase in alpha wave activity. Alzheimer's patients demonstrated reductions in agitation and anxiety, and caregivers reported intermittent improvements in clarity and presence. Additional observations across occupational groups included reductions in stress and reported improvements in focus and patience among corporate professionals, students, and homemakers. These findings are preliminary and should be considered exploratory regarding the role of meditative practices in dementia care. The absence of a control group suggests that confirmation through randomized controlled trials is warranted. These results indicate that integrating traditional meditative practices with contemporary neuroscientific approaches may provide accessible, non-pharmacological support for individuals with neurodegenerative disorders. In clinical practice, OM chanting could potentially be included in dementia care routines by instructing caregivers or facilitators to lead these sessions and incorporate them in daily activities, such as exercise or cognitive therapy. Incorporating OM chanting into multidisciplinary care plans may provide a holistic approach by enhancing emotional wellbeing and cognitive function, thereby complementing pharmacological treatments. Implementation could be achieved through workshops, training sessions, or integration into community health programs.

***Index Terms*—Alzheimer's Disease, Brainwave patterns, Cognitive enhancement, EEG, Fourier transform, Neurophysiology, OM chanting, Meditation therapy, Neurodegenerative disorders, Psychological wellbeing**

I. INTRODUCTION

Every three seconds, an individual worldwide is diagnosed with Alzheimer's Disease. By 2050, the affected population is projected to reach 152 million. Alzheimer's is characterized by memory loss and confusion, impacting both patients and their families. The disease is associated with amyloid plaques (abnormal clumps of the protein beta-amyloid) and tau tangles (twisted fibers formed from the protein tau) that damage brain cells, particularly in regions of the brain responsible for memory. Emerging evidence indicates that amyloid pathologies are linked to disrupted neural oscillations (repetitive patterns of brain electrical activity), which influence brain wave rhythms such as alpha (8–12 Hz, common during calm wakefulness) and theta (4–8 Hz, prominent during light sleep and relaxation). Current medications, including cholinesterase inhibitors (drugs that increase the amount of the chemical messenger acetylcholine in the brain) and NMDA receptor antagonists (drugs that block excessive

glutamate activity to prevent nerve cell damage), can temporarily reduce symptoms but do not halt disease progression. Utilizing EEG-based (electroencephalography, a noninvasive test to record electrical brain activity) interventions to assess and potentially modify these oscillations is a possible therapeutic approach. Consequently, families and researchers continue to investigate new approaches that may improve patient outcomes.

1.1 The COVID-19 Pandemic: A Perfect Storm for Alzheimer's and Sleep Disorders

The onset of the COVID-19 pandemic in 2020 highlighted the vulnerability of individuals with Alzheimer's Disease. Beyond the direct impact of the virus, the pandemic led to increased isolation, disrupted routines, and heightened mental health challenges. Elderly individuals with Alzheimer's and other dementias faced higher mortality rates and accelerated cognitive decline. Emerging research suggests that COVID-19 may increase the risk of Alzheimer's Disease by potentially triggering or accelerating neurodegenerative processes.

The pandemic's effects on brain health extended beyond those already diagnosed with Alzheimer's. COVID-19 can have lasting impacts on the brain, especially in older adults. Severe acute infection was linked with declines in memory, language, and executive function. The virus affected not just the lungs but also the mind, resulting in "long COVID," characterized by persistent brain fog, memory problems, and cognitive impairment.

Sleep disturbances became widespread during the pandemic, with approximately 40% of individuals worldwide reporting sleep problems. According to WHO data, 10-20% of post-COVID survivors experienced persistent issues, making sleep disturbance a leading complaint and highlighting the pandemic's prolonged impact.

<cite index="13-14">In one study, 91.9% of participants were confirmed SARS-CoV-2 positive, 36.8% complained of poor sleep quality, and 89.7% reported insomnia</cite>. These statistics underscore the widespread impact of the pandemic on sleep quality and mental health, particularly among vulnerable populations.

Previous outbreaks such as SARS and MERS demonstrated links between illness and increased depression, anxiety, and sleep disturbances. The unique challenges of COVID-19, including prolonged stress and social isolation, intensified these mental health and cognitive concerns, especially for individuals with Alzheimer's.

During COVID-19, Alzheimer's patients and caregivers faced greater challenges. Loss of routine, closure of day programs, and limited access to care increased isolation, accelerating cognitive decline.

Sleep disturbances increased among Alzheimer's patients during the pandemic. <cite index="13-1,13-17">The elderly, women, urban residents, those with comorbidities, anxiety, depression, stress, and COVID-19 infection face higher risks for sleep disorders</cite>. Poor sleep worsens Alzheimer's symptoms, leading to a cycle where disrupted sleep and disease acceleration coexist with anxiety and behavioral changes.

The mechanisms involved are complex but significant. Angiotensin-converting enzyme 2 (ACE2)—a receptor on the surface of many cell types— is overexpressed in brains with Alzheimer's Disease, which may increase viral invasion. Neuroinflammation (swelling in the brain due to immune response) and oxidative stress (cell damage caused by unstable molecules called free radicals) present in AD patients can enhance the inflammatory response associated with COVID-19. This combination may increase vulnerability to both the virus and its neurological effects for Alzheimer's patients.

This research was conducted in Bengaluru, India, in early 2024, during the post-pandemic period marked by ongoing psychosocial challenges. Participants included corporate workers experiencing increased stress from remote work, students facing educational disruptions and anxiety, elderly individuals with cognitive decline, and Alzheimer's patients whose families sought supportive interventions.

Participants in this study experienced insomnia, anxiety, cognitive difficulties, and emotional distress following the pandemic. Many were interested in whether OM chanting, an ancient practice, could provide benefits that modern medicine has not yet

achieved. OM, considered a sacred sound in Hindu and other Eastern traditions, is believed to represent the primordial sound of the universe and is used in meditation to promote mental clarity, emotional stability, and inner peace. While regular practitioners report reduced stress and improved focus, the scientific basis for these effects, especially in neurodegenerative conditions like Alzheimer's Disease, is not well understood. As interest in mindfulness and meditation-based interventions grows, it is important to study their effects on brain activity in clinical populations. Techniques such as mindfulness-based stress reduction and mantra meditation have shown positive effects on cognitive function and emotional well-being. Research indicates that regular meditation can lower stress hormones, improve emotion regulation, and increase cognitive flexibility. However, the specific impact of OM chanting on brain function has not been thoroughly examined using neurophysiological tools like EEG. To our knowledge, no study has combined OM chanting with EEG in AD patients. Previous studies by Manshouri et al. have shown that EEG can effectively detect changes in cognition and perception. For example, studies have found that EEG power changes during 2D–3D video transitions and sleep can reflect cognitive strain and other mental states. EEG is a valuable, non-invasive method for measuring brain activity across different frequency bands, including delta, theta, alpha, beta, and gamma.

The states of consciousness correspond to delta, theta, alpha, beta, and gamma waves. Research indicates that increased alpha and theta waves correlate with decreased stress and improved emotional regulation, while excess beta activity correlates with increased anxiety and cognitive overload. This study aims to investigate the effects of OM chanting on brainwave patterns to examine, first, possible cognitive and therapeutic benefits. Although there have been a few neuroimaging studies of mantra meditation, OM chanting has not been explored much. The authors studied OM chanting in a functional magnetic resonance imaging (fMRI) study. They found significant deactivation in brain areas, such as the orbitofrontal cortex and hippocampus, similar to what is observed in brain regions deactivated during treatment with vagus nerve stimulation for depression and epilepsy. A study by Kuppusamy et al. demonstrated that chanting interventions can also reduce stress levels among healthcare workers experiencing occupational burnout; therefore, they are used to manage occupational burnout. Yet, most existing studies are on general mantra chanting or at the subject level and are not precise regarding real-time brainwave activity. Using EEG to study brain activity before, during, and after OM chanting, this research measures changes in each brainwave frequency to assess cognitive and emotional shifts. The dynamic, real-time view of brain function made possible by EEG makes it a valuable tool for detecting subtle neurophysiological changes in the brain resulting from meditation. It will also use Fourier Transform (FT) techniques to decompose the recorded EEG signals into their constituent frequencies, enabling precise analysis in both the time and frequency domains.

One proposed mechanism of OM chanting's effects is activation of the vagus nerve, which can increase parasympathetic nervous system activity, promoting relaxation and stress reduction. Additionally, OM chanting may modulate the Default Mode Network (DMN), a brain network associated with self-referential thought and reduced activity during focused attention tasks. This modulation may enhance cognitive flexibility and emotional regulation. The aim is to determine whether OM chanting affects brainwave synchronicity and relaxation, and whether it can potentially help alleviate stress, anxiety, and cognitive impairment. Alternatives to meditation and mantra chanting, however, with the World Health Organization (WHO) estimating that anxiety and depression affect over 264 million people worldwide, are becoming popular. Using the OM did seem to promote relaxation or attention regulation, potentially making it a valuable tool in clinical and non-clinical settings. When linked to the ancient spiritual practices, this will help bridge the gap between the two and offer new neurotherapeutic avenues. This study aims to provide data on how OM chanting affects brainwave activity and contributes to the growing body of literature on this topic. The research systematically investigates EEG data to identify the specific types of brain waves associated with relaxation, focus, and

emotional regulation. Future studies on the long-term benefits of this approach could yield valuable findings and inform a more integrative understanding of well-being, encompassing both mind-body and bodymind interactions.

II. LITERATURE REVIEW

Thus, the effects of OM chanting on brain waves are investigated. OM chanting induces significant changes in brain activity associated with relaxation and emotional processing. OM chanting is being studied to examine its effects on brain waves that resemble a meditative state, and is used for relaxation and stress reduction. This synthesis of findings brings together what is known in scientific inquiry and what is practiced in spiritual practice in connection with OM chanting. Past studies have found that OM chanting increases alpha EEG levels, indicating a correlation with increased relaxation and reduced stress [7]. Moreover, theta power also increases in all brain areas following OM chanting, and this change is correlated with a state of relaxation [8]. Additionally, fractal analysis of EEG signals reveals changes in complexity during OM chanting [9]. As part of the latter, OM chanting also influences cortical activity and emotional processing, beyond brain wave activity. Verbal chanting or simply listening to the sound of OM has been found to activate the same brain areas associated with attention and relaxation [10]. Additionally, OM chanting has been shown to reduce emotional responses to negative stimuli, suggesting its use as a means of emotional regulation [11]. This follows research on the effect of mindfulness and meditation in general. It has become a scientific area of interest due to its various effects on brain activity, cognition, and emotional well-being. Some studies suggest that the expertise of meditation is associated with specific patterns of functional connectivity in the brain. Studies demonstrate that expert mediators integrate larger-scale brain networks, including somatomotor, attention, limbic, and front parietal networks, and they have more ability to generate psychological distancing from thoughts and emotions than less experienced mediators [12], [13]. That might imply that, if you meditate over a long period of time, you can also get permanent changes in brain function. It was found that mantra chanting, a form of meditation, significantly alters brainwave activity. The second piece of research analyzed experienced OM mantra chanters and found that in chanting, there was an increase in the EEG frequency bands, Alpha (10%), Gamma (13%), Beta (23%), and Delta (16%), which represents a deeper state of relaxation and focus [14], [15]. The results show that the effects of mantra-based meditation are cognitive and neurophysiological. In addition, researchers advocate integrating various religiously derived meditative practices into the field of international public health. For example, worldview-dependent meditation practices drawn from the Christian tradition may be offered as options to different communities according to their cultural and religious contexts [16], [17]. Findings have revealed that both vocal and silent chanting can lower cortisol and self-reported anxiety, and vocal chanting is more effective in reducing anxiety [18], [19]. Thus, the utterance of the chant or its automatic internalization seems to have measurable physiological and psychological effects. Although it increased altruism scores, it did not affect them beyond a person's own national culture. Further neuroimaging studies support the use of spiritual technologies, such as mantra chanting, which alter brain function and facilitate changes in the 'default mode network' (DMN). These findings could have implications for the relationship between spirituality or religiosity and mental health [20], [21]. Additionally, using portable EEG devices in the smart home environment provides an opportunity to investigate the effects of meditation on other cognitive states, such as during mindfulness or Kirtan Kriya meditation [22]. Using single-channel data, Kayikcioglu et al. (2015)[23] and Maleki et al. (2018)[24] developed effective EEG classification systems, demonstrating the feasibility of straightforward and affordable neural analysis. The 2015 study employed a PLS-based method for accurate automated sleep stage detection. The 2018 study demonstrated the accurate classification of cognitive states by extending these techniques to a real-time brain-computer interface (BCI). These experiments demonstrate that low-complexity EEG devices are feasible for BCI and therapeutic settings. These studies bridge the gap between traditional spiritual practices and contemporary neuroscience, offering a scientific explanation for the benefits of mantra chanting and meditation on brain function.

III. METHODOLOGY

We asked whether daily OM chanting causes measurable EEG shifts in Alzheimer's Disease patients. This systematic investigation employed a quasi-experimental pre-post design to examine neurocognitive and psychological changes following the OM chanting intervention. EEG was used to monitor real-time changes in brain activity before and after OM chanting, providing quantitative data on alterations in cognitive and emotional processing.

3.1 Participant Selection and Characteristics

A total of 120 participants from Bengaluru, India, were recruited for this study, representing a range of backgrounds and life circumstances. Participants were sourced from memory clinics, corporate offices, households, and academic institutions, ensuring a diverse sample across age, occupational, and cognitive status categories. The study aimed to systematically assess the impact of OM chanting on individuals at various life stages and with differing stressors and cognitive profiles.

Age Categories:
- Young Adults (20-35 years): n=30 (25%)
- Middle-Aged Adults (35-55 years): n=35 (29.2%)
- Older Adults (55-70 years): n=30 (25%)
- Senior Citizens (70+ years): n=25 (20.8%)

Gender Distribution:
- Males: n=48 (40%)
- Females: n=52 (43.3%)
- Boys (ages 20-25): n=10 (8.3%)
- Girls (ages 20-25): n=10 (8.3%)

Occupational/Life Stage Categories:
- Corporate Workers: n=35 (29.2%)
- Householders (homemakers): n=28 (23.3%)
- Students (Boys/Girls): n=20 (16.7%)
- Senior Citizens (retired): n=25 (20.8%)
- Other Professionals: n=12 (10%)

For the Alzheimer's Disease subgroup (n=25, representing 20.8% of the total sample):
- Age range: 62-78 years (mean age: 69.4 ± 4.2 years)
- Gender: Male: 12, Female: 13
- All classified as the Senior Citizens category

Inclusion Criteria (AD subgroup): (1) clinical diagnosis of probable AD according to National Institute on Aging-Alzheimer's Association (NIA-AA) criteria; (2) Mini-Mental State Examination (MMSE) scores between 10-24, indicating mild to moderate cognitive impairment; (3) stable medication regimen for at least 4 weeks; (4) absence of severe hearing impairment; (5) ability to vocalize and follow simple instructions.

Inclusion Criteria (Non-AD participants): (1) no diagnosed neurological or severe psychiatric disorders; (2) ability to commit to 4-week intervention protocol; (3) willingness to practice OM chanting daily; (4) no prior regular meditation practice (defined as <1 session per month in past 6 months).

Exclusion Criteria (all participants): (1) history of epilepsy or seizure disorders; (2) severe psychiatric conditions requiring hospitalization; (3) recent hospitalization (within 4 weeks); (4) pacemaker or other contraindications for EEG; (5) severe hearing or vocal impairments preventing participation.

Written informed consent was obtained from all participants (and legal caregivers for AD patients). The study was conducted between January 2024 and June 2024 at neurocognitive research facilities in Bengaluru, Karnataka, India. The study received ethical approval from the Institutional Review Board.

3.2 Cognitive and Psychological Assessment

Baseline cognitive function was assessed using the MMSE and Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog). Psychological parameters, including anxiety (Geriatric Anxiety Inventory), depression (Geriatric Depression Scale), and quality of life (Quality of Life-AD scale), were measured before and after the intervention period. Behavioral disturbances were evaluated using the Neuropsychiatric Inventory (NPI).

3.3 EEG Data Acquisition

The study environment was carefully controlled to ensure reliable data collection, with consideration given to room size, layout, lighting, noise levels, accessibility, and privacy to minimize visual and auditory distractions. Data acquisition was conducted

in a dedicated EEG laboratory in Bengaluru equipped with acoustic insulation and electromagnetic shielding. According to the International 10-20 System, wet silver/silver chloride (Ag/AgCl) electrodes were placed on standardized scalp locations covering frontal, central, parietal, temporal, and occipital regions. Electrode impedance was maintained below 5 kΩ using conductive paste to enhance signal clarity and minimize noise interference. The EEG recorder, a Biosonic system with a 256 Hz sampling rate, captured brainwave frequencies ranging from 0.5 to 50 Hz, suitable for studying cognitive states in AD patients.

The experimental flow began with a 5-minute baseline EEG recording while participants rested quietly with eyes closed in a comfortable seated position. Following baseline recording, participants engaged in guided OM chanting sessions lasting 15-20 minutes, depending on participants' comfort and experience level. For AD patients and beginners, sessions started at 10 minutes and progressively extended to 15-20 minutes. For participants with verbal difficulties, passive listening to recorded OM chanting was permitted, with vocal participation encouraged when possible. The OM mantra was vocalized at a consistent pace (approximately 6-8 repetitions per minute) to maintain standardization. Notably, the completion rate for AD patients was 90%, demonstrating high acceptability and adherence to the chanting sessions. Immediately after chanting, a 5-minute post-intervention EEG recording was conducted under identical conditions to capture immediate neurophysiological effects.

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Timing Flexibility: Recognizing the diverse schedules of participants across different life stages and occupational categories, OM chanting sessions were permitted at multiple times throughout the day:

- Early Morning (5:00-7:00 AM): Preferred time, recommended for maximum benefits (n=52 participants, 43.3%)
- Before Breakfast (7:00-9:00 AM): Suitable for working professionals and students (n=28 participants, 23.3%)
- Before Lunch/Noon (11:00 AM-1:00 PM): Convenient for householders and flexible schedules (n=15 participants, 12.5%)
- Evening (5:00-7:00 PM): Popular among corporate workers post-work (n=18 participants, 15%)
- Before Dinner (7:00-9:00 PM): Suitable for family practice (n=5 participants, 4.2%)
- Before Sleep (9:00-10:30 PM): Relaxation-focused sessions (n=2 participants, 1.7%)

While participants could practice at any of these times, they were instructed to maintain consistency in their chosen time slot throughout the 4-week intervention to control for circadian variations. Laboratory EEG sessions were scheduled according to each participant’s preferred practice time to ensure ecological validity.

3.4.1 OM Chanting Practice Protocol

The OM chanting practice followed a standardized protocol adapted for Alzheimer’s Disease patients to ensure consistency, safety, and accessibility:

Posture and Environment: The study environment was designed to promote relaxation and minimize distractions. Participants were seated in supportive chairs, with their feet flat on the floor and their hands resting on their laps or knees. The room featured soft lighting and a stable temperature of 20-22°C to ensure comfort. For Alzheimer’s Disease patients, caregivers were present in the room to provide support while minimizing potential distractions.

Breathing Preparation: Each session began with 2-3 minutes of guided breathing exercises. Participants were instructed to inhale slowly through the nose and exhale through the mouth, facilitating relaxation and preparing for the OM chanting practice. This preparatory phase aimed to reduce anxiety and promote a calm mental state prior to the intervention.

OM Vocalization Technique: The OM sound was produced in three distinct phases, representing the syllable's traditional composition as A-U-M:

- 'A' (ah) sound: Vocalized from the abdomen and chest, with mouth wide open, lasting approximately 3-4 seconds
- 'U' (oo) sound: Transitioning smoothly as lips gradually round, vibration moving to the throat and palate, lasting 3-4 seconds
- 'M' (mmm) sound: Lips closed gently, creating nasal resonance and cranial vibration, sustained for 4-5 seconds

The complete OM vocalization lasted approximately 10-12 seconds, followed by a natural breath and 3-5 seconds of silent pause before the next repetition. This resulted in 6-8 complete OM cycles per minute.

Guidance and Modeling: Our facilitator became more than an instructor; she was the heart of each session, her voice setting the tone and inviting everyone to join. As she began, her OM filled the space, not as a command but as a warm welcome. During the first few repetitions, she chanted with the group, her voice blending with theirs and creating a sense of unity. Gradually, she stepped back, allowing participants to discover their own voices and rhythms. She stayed attentive, offering gentle words of encouragement when needed: "Take a deep breath, you're doing beautifully," or "Let the sound flow naturally, there's no wrong way." For Alzheimer's patients who sometimes lost track mid-session, these soft prompts became gentle anchors, guiding them back to the present.

Adaptations for AD Patients: Several modifications accommodated the specific needs of Alzheimer's patients:

- Visual cues: Simple hand gestures indicating when to breathe in and when to chant
- Simplified instructions: Short, repeated phrases rather than complete. Guidance and Modeling: The facilitator began each session by demonstrating the OM chanting technique, chanting alongside participants for the initial repetitions to establish rhythm and tone. Subsequently, participants continued independently, with the facilitator providing verbal encouragement and corrective feedback as needed. For Alzheimer's Disease patients, brief reminders and supportive cues were offered to maintain engagement and participation. Training: The intervention included a 4-week daily practice regimen with duration adapted to participant categories:

For AD Patients and Senior Citizens (70+ years):
- Week 1: 5-10 minute sessions to build familiarity and comfort
- Week 2:10-12 -minute sessions with increased confidence- Weeks 3-4: 12-15 minute sessions for therapeutic effect

For Older Adults (55-70 years) and Householders:
- Week 1: 10-12 minute sessions
- Week 2: 12-15 minute sessions
- Weeks 3-4: 15-18 minute sessions

For Middle-Aged Adults (35-55 years) and Corporate Workers:
- Week 1: 12-15 minute sessions
- Week 2: 15-18 minute sessions
- Weeks 3-4: 18-20 minute sessions

For Young Adults (20-35 years), Boys, and Girls:
- Week 1: 15-minute sessions
- Week 2: 17-minute sessions
- Weeks 3-4: 20-minute sessions for optimal benefits

All participants were encouraged to practice daily at their chosen consistent time. The recommended duration range of 15-20 minutes was achieved by most participants (n=95, 79.2%) by week 4, with exceptions made for those with physical or cognitive limitations.

Home Practice: Participants were encouraged to practice OM chanting at home with caregiver

support. Audio recordings of guided OM chanting sessions were provided. Practice logs were maintained by caregivers to track frequency and duration of home practice.

Safety Monitoring: Throughout each session, facilitators monitored participants for signs of discomfort, hyperventilation, dizziness, or agitation. Sessions could be paused or terminated if any adverse reactions occurred. No adverse events were reported during the study period.

This standardized yet flexible protocol ensured that OM chanting practice was accessible to AD patients with varying levels of cognitive impairment while maintaining sufficient consistency for scientific investigation.

3.5 Signal Processing and Analysis

Noise reduction techniques were applied during signal acquisition to preserve data integrity. Low-pass filters (attenuating frequencies above 50 Hz), notch filters (removing 50/60 Hz powerline interference), and median filters (reducing impulsive noise) were implemented. EEG signals were decomposed into five frequency bands: delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-13 Hz), beta (13-30 Hz), and gamma (30-50 Hz). Fourier Transform techniques enabled precise frequency domain analysis. Statistical comparisons between pre- and post-intervention data were performed using paired t-tests, with $p < 0.01$ as the significance threshold. To correct for multiple comparisons, we applied the Bonferroni correction, ensuring that the detected effects are statistically significant and not attributable to random variation. Effect sizes were also calculated using Cohen's d to provide a measure of the magnitude of these changes.

IV. RESULTS AND DISCUSSION

Figure 4. EEG signal comparison showing amplitude and frequency changes before and after OM chanting across different brain regions (Frontal, Central, Parietal, Temporal, Occipital). The graphs demonstrate a significant reduction in signal amplitude and increased stability post-intervention.

Figure 5. Frequency domain analysis of brainwave patterns showing increased alpha and theta power, decreased beta activity, and improved signal-to-noise ratio following a 4-week OM chanting intervention in AD patients.

The neurocognitive and psychological effects of OM chanting in Alzheimer's Disease patients were investigated through a comprehensive analysis of brainwave patterns and clinical assessments, revealing significant therapeutic potential for this non-pharmacological intervention.

4.1 Neurophysiological Changes Across Participant Categories

EEG analysis revealed substantial alterations in brainwave patterns following OM chanting intervention across all participant groups, with variations by age, gender, and occupational status.

Overall Sample (n=120):
- Alpha wave relative power increased by 34.2% ($p < 0.001$), indicating enhanced relaxation and reduced cortical arousal
- Theta/beta ratio improved by 85.4% ($p < 0.001$), suggesting enhanced emotional regulation and reduced anxiety
- Beta wave activity decreased by 28.6% ($p < 0.001$), reflecting reduced stress and cognitive overload
- EEG signal variance decreased by 82.22% ($p < 0.001$), indicating greater neural stability
- Interhemispheric coherence increased by 41.3% ($p < 0.001$), particularly in frontal and temporal regions
- Signal-to-noise ratio improved by 23.36% ($p < 0.01$)

Age-Category Specific Findings:

Young Adults (20-35 years, n=30):
- Alpha increase: 28.5% ($p < 0.01$)
- Theta/beta improvement: 62.3% ($p < 0.001$)
- Notable gamma band enhancement: 18.4% ($p < 0.05$), suggesting improved cognitive processing
- Fastest achievement of relaxed state (average 3.2 minutes into practice)

Middle-Aged Adults (35-55 years, n=35):
- Alpha increase: 36.8% ($p < 0.001$) - highest among all groups
- Theta/beta improvement: 78.5% ($p < 0.001$)

- Beta reduction: 32.4% ($p < 0.001$) - significant for stress management
- Corporate workers in this category showed 42.1% beta reduction ($p < 0.001$)

Older Adults (55-70 years, n=30):
- Alpha increase: 31.7% ($p < 0.001$)
- Theta/beta improvement: 88.2% ($p < 0.001$)
- Delta wave stabilization: 24.6% improvement ($p < 0.01$)
- Enhanced interhemispheric coherence: 45.8% ($p < 0.001$)

Senior Citizens (70+ years, n=25, including AD subgroup):
- Alpha increase: 38.9% ($p < 0.001$) - particularly significant given age-related alpha decline
- Theta/beta improvement: 95.7% ($p < 0.001$) - greatest improvement
- Signal variance reduction: 86.5% ($p < 0.001$)

The study found that alpha wave activity increased by 34.2% ($p < 0.001$), a significant finding given that AD patients typically exhibit reduced alpha activity. This increase correlates with more relaxed states in their daily routines, potentially reducing stress-related agitation and improving overall mood stability. However, it is important to note that these findings are correlational; without a control group, we cannot establish a definitive causal link between the increased alpha activity and the reported clinical improvements.

The 85.4% improvement in the theta/beta ratio ($p < 0.001$) was critical for managing behavioral symptoms, as evidenced by many caregivers reporting at least 2 fewer instances of patient agitation per day. While these EEG changes indicate potential areas for targeted care strategies, the absence of a control group prevents them from being conclusively linked to the observed behavioral changes.

Beta wave activity decreased by 35.8% ($p < 0.001$), indicating fewer confusion and agitation episodes. This reduction implies that patients may experience fewer mood swings and increased coherence in thought processes. Interhemispheric coherence improved by 38.7% ($p < 0.01$), suggesting that compensatory neural mechanisms might be strengthening, contributing to increased cognitive stability and attentiveness. Although these EEG findings are promising, they should be interpreted with caution and seen as a correlation rather than causation. By acknowledging these limitations, caregivers can better tailor daily routines and therapeutic interventions to maximize patient benefits while recognizing the need for further research to establish causal relationships.

Gender-Based Differences:

Males (n=48):
- Alpha increase: 31.5% ($p < 0.001$)
- Theta/beta improvement: 79.8% ($p < 0.001$)
- Greater beta reduction: 31.2% ($p < 0.001$)

Females (n=52):
- Alpha increase: 36.4% ($p < 0.001$) - slightly higher than males
- Theta/beta improvement: 90.2% ($p < 0.001$) - significantly higher emotional regulation
- Enhanced interhemispheric coherence: 44.7% vs. 38.2% in males ($p < 0.05$)

Occupational Category Findings:

Corporate Workers (n=35):
- Beta reduction: 38.5% ($p < 0.001$) - highest among occupational groups, indicating significant stress relief
- Alpha increase: 35.2% ($p < 0.001$)
- Reported subjective stress reduction correlated strongly with beta decrease ($r = 0.72$, $p < 0.001$)

Householders (n=28):
- Alpha increase: 37.1% ($p < 0.001$)
- Theta/beta improvement: 91.3% ($p < 0.001$) - excellent emotional regulation
- Enhanced delta wave stability: 22.8% ($p < 0.01$), suggesting improved sleep quality

Students - Boys/Girls (n=20):
- Alpha increase: 29.3% ($p < 0.01$)
- Gamma enhancement: 21.5% ($p < 0.05$) - highest among all groups, indicating enhanced focus and learning capacity
- Theta/beta improvement: 65.4% ($p < 0.001$)

- Attention-related improvements are most pronounced in this group

Practice Timing Effects:
Participants practicing early morning (5:00-7:00 AM) showed significantly greater alpha increases (39.2% vs. 31.4%, $p < 0.05$) and theta/beta improvements (92.1% vs. 78.3%, $p < 0.05$) compared to evening practitioners, supporting traditional recommendations for morning practice.

4.2 Cognitive Function Outcomes
Post-intervention cognitive assessments showed measurable improvements in Alzheimer's patients, with an average increase of 1.8 points on cognitive tests. While not a cure, these gains included longer attention spans and improved consistency in daily activities. Caregivers reported increased moments of clarity and presence, contributing to enhanced quality of life for both patients and families. Although memory did not significantly improve, patients were calmer and more engaged.

Post-intervention cognitive assessments showed meaningful improvements across participant groups, with variations by age, baseline cognitive status, and practice duration.

Alzheimer's Disease Patients (n=25):
- MMSE scores increased by 1.8 points ($p < 0.05$) after 4 weeks
- ADAS-Cog scores improved by 2.3 points ($p < 0.05$), particularly in attention and language domains
- Attention span improved by 18% ($p < 0.01$)
- Memory recall showed non-significant trends toward improvement
- Caregiver-reported functional improvements in 76% of cases

Senior Citizens without AD (70+ years, n=25):
- Cognitive processing speed improved by 12.4% ($p < 0.05$)
- Attention span improved by 22% ($p < 0.01$)
- Verbal fluency enhanced by 15.8% ($p < 0.05$)
- Working memory capacity improved by 14.2% ($p < 0.05$)

Older Adults (55-70 years, n=30):
- Executive function scores improved by 16.7% ($p < 0.01$)
- Attention and concentration improved by 24.5% ($p < 0.001$)
- Memory consolidation showed 11.3% improvement ($p < 0.05$)
- Processing speed enhanced by 13.8% ($p < 0.05$)

Middle-Aged Adults (35-55 years, n=35):
- Sustained attention improved by 26.8% ($p < 0.001$)
- Cognitive flexibility enhanced by 19.4% ($p < 0.01$)
- Working memory improved by 17.6% ($p < 0.01$)
- Corporate workers showed particular improvements in multitasking ability: 21.3% ($p < 0.01$)

Young Adults (20-35 years, n=30):
- Focus and concentration improved by 28.7% ($p < 0.001$) - the greatest improvement
- Learning efficiency enhanced by 23.5% ($p < 0.001$)
- Creative problem-solving improved by 20.8% ($p < 0.01$)
- Students (Boys/Girls) showed academic performance correlation: 18.5% improvement in test scores ($p < 0.05$)

Occupational Categories:

Corporate Workers (n=35):
- Decision-making speed improved by 19.8% ($p < 0.01$)
- Task-switching efficiency enhanced by 22.4% ($p < 0.01$)
- Sustained attention during work hours improved by 27.3% ($p < 0.001$)
- Reported productivity increase: 24.6% (self-reported, $p < 0.05$)

Householders (n=28):
- Multitasking ability improved by 18.9% ($p < 0.01$)
- Memory for daily tasks enhanced by 16.7% ($p < 0.05$)
- Mental clarity improved by 25.4% ($p < 0.001$)

Practice Duration Effects:
Participants achieving 18-20 minute daily sessions showed 1.3-1.5× greater cognitive improvements compared to those practicing 12-15 minutes ($p < 0.05$), supporting the recommended 15-20 minute duration.

4.3 Psychological and Behavioral Outcomes

Psychological assessments revealed significant improvements in emotional well-being across all participant categories. These psychological shifts closely align with neurophysiological changes, particularly improvements in the theta/beta ratio, which are associated with reduced anxiety and improved emotional regulation.

Alzheimer's Disease Patients (n=25):
- Geriatric Anxiety Inventory: 28% decrease ($p < 0.01$), correlated with an enhanced theta/beta ratio- Geriatric Depression Scale: 22% decrease ($p < 0.05$)
Quality of Life-AD: 15% improvement ($p < 0.05$)
Neuropsychiatric Inventory: 31% decrease ($p < 0.01$), particularly in agitation, anxiety, and irritability
, linked to improved brain coherence- Caregiver burden reduced by 24% ($p < 0.05$)

Senior Citizens without AD (70+ years, n=25):
- Anxiety levels decreased by 32% ($p < 0.001$)
- Depression symptoms reduced by 28% ($p < 0.01$)
- Life satisfaction increased by 22% ($p < 0.01$)
- Social engagement improved by 18.5% ($p < 0.05$)

Older Adults (55-70 years, n=30):
- Stress levels decreased by 34.6% ($p < 0.001$)
- Anxiety reduced by 29.8% ($p < 0.001$)
- Emotional stability improved by 26.4% ($p < 0.01$)
- Sleep quality enhanced by 31.2% ($p < 0.001$)

Middle-Aged Adults (35-55 years, n=35):
- Perceived stress decreased by 38.7% ($p < 0.001$) - the highest reduction
- Anxiety levels reduced by 33.5% ($p < 0.001$)
- Mood elevation: 27.8% improvement ($p < 0.001$)
- Work-life balance satisfaction improved by 29.4% ($p < 0.01$)

Young Adults (20-35 years, n=30):
- Stress reduction: 35.2% ($p < 0.001$)
- Anxiety decrease: 31.7% ($p < 0.001$)
- Emotional regulation improved by 28.9% ($p < 0.001$)
- Self-reported happiness increased by 24.6% ($p < 0.01$)

Gender-Based Differences:
Males (n=48):
- Stress reduction: 32.4% ($p < 0.001$)
- Anger management improved by 26.8% ($p < 0.01$)
- Emotional expression enhanced by 19.5% ($p < 0.05$)

Females (n=52):
- Anxiety reduction: 36.8% ($p < 0.001$) - significantly higher than males
- Emotional well-being improved by 31.2% ($p < 0.001$)
- Mood stability enhanced by 29.7% ($p < 0.001$)

Occupational Categories:

Corporate Workers (n=35): After four weeks of OM chanting, corporate participants experienced a 42.3% reduction in work-related stress, the largest decrease among all groups. Burnout symptoms declined by 36.8%, sleep quality improved by 33.9%, and job satisfaction increased by 28.5%. Workplace anxiety decreased by 34.7%. These results indicate that OM chanting may effectively support stress management and well-being in high-pressure professional environments.

Householders (n=28): After four weeks of OM chanting, householders reported a 35.6% reduction in daily life stress and a 32.4% improvement in emotional well-being. Family relationship quality improved by 21.8%, and patience increased by 27.3%. These results suggest that OM chanting may be beneficial for managing stress and enhancing emotional resilience in individuals with significant caregiving responsibilities.

Students - Boys/Girls (n=20): Four weeks of daily OM chanting led to a 33.8% reduction in academic stress and a 38.5% decrease in test anxiety. Emotional resilience improved by 25.7%, self-confidence increased by 22.4%, and academic performance improved by 18.5%. These results suggest OM chanting may support stress management and academic achievement in students.

Practice Timing Correlations:
Early morning practitioners (5:00-7:00 AM) reported 1.4× greater improvements in overall well-being

compared to evening practitioners ($p < 0.05$). Before-sleep practice showed particular benefits for sleep quality (42.6% improvement, $p < 0.001$).

Correlation analysis revealed significant relationships between neurophysiological changes and clinical improvements. To enhance clarity, a concise roadmap could be added: sound → vagal activation → reduced inflammation. This causal chain begins with the vibration and sound of OM chanting, which stimulates the vagus nerve, resulting in activation of relaxation responses and a reduction in inflammation-related markers. These physiological effects are reflected in the increased alpha power, which is strongly correlated with reduced anxiety ($r = -0.67$, $p < 0.01$) and improved quality of life ($r = 0.58$, $p < 0.01$). An improved theta/beta ratio correlates with reduced behavioral disturbances ($r = -0.61$, $p < 0.01$), while enhanced interhemispheric coherence correlates with improved attention scores ($r = 0.54$, $p < 0.05$). These correlations suggest that the neurophysiological changes induced by OM chanting translate into meaningful clinical benefits for AD patients.

The significant neurophysiological changes observed following OM chanting intervention in AD patients suggest multiple therapeutic mechanisms. The increased alpha activity may reflect enhanced parasympathetic nervous system activation, promoting relaxation and reducing the chronic stress that exacerbates cognitive decline in AD. The improved theta/beta ratio suggests better emotional regulation, addressing the behavioral and psychological symptoms of dementia (BPSD) that significantly impact quality of life. Enhanced interhemispheric coherence may represent compensatory neural mechanisms, potentially strengthening remaining neural networks to partially offset AD-related degradation. The rhythmic, repetitive nature of OM chanting may provide cognitive structure and predictability, reducing confusion and anxiety in AD patients. The vibrational qualities of the OM sound may plausibly stimulate vagal nerve activity, which has been associated with improved mood and reduced inflammation, factors relevant to AD pathophysiology. These findings align with previous research showing meditation interventions can modulate default mode network activity, enhance attention, and reduce stress-related neural patterns. The specific application to AD patients represents a novel contribution, demonstrating that even cognitively impaired individuals can benefit from this accessible, non-invasive intervention.

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Several limitations must be acknowledged. The relatively small sample size (n=25) limits statistical power and generalizability. The absence of a control group receiving alternative interventions or no intervention prevents definitive causal attribution. The study examined only immediate and short-term effects (4 weeks); long-term impacts on disease progression remain unknown. Individual variability in disease severity, medication regimens, and prior meditation experience may have influenced outcomes but were not fully controlled. The study did not differentiate between active chanting and passive listening effects. Environmental factors, caregiver involvement, and expectancy effects may have

contributed to observed improvements. EEG has lower spatial resolution than neuroimaging techniques such as fMRI, limiting the detailed localization of neural changes. The study did not assess potential mechanisms such as neuroplasticity markers, inflammatory biomarkers, or neurotransmitter changes. The study was conducted in a single urban center (Bengaluru, India) with participants from predominantly middle- to upper-socioeconomic backgrounds, which may limit generalizability to rural populations and to different cultural contexts. Cultural familiarity with OM chanting practices in the Indian context may have influenced participant receptivity and outcomes differently than in other cultural settings. Expectancy and placebo effects may have played a role, as participants might have anticipated positive outcomes based on their belief in the benefits of OM chanting. This could introduce bias, as participants' expectations can sometimes lead to perceived or actual improvements. Future research should consider implementing blinding techniques where practical and include a placebo-controlled group to minimize these biases. Additionally, the cultural significance of OM chanting in India may have created an inherent receptiveness to the practice, distinguishing it from potential outcomes in cultures where OM chanting holds different meanings or is less well-known. Addressing cultural bias in future studies may involve conducting similar research in varied cultural settings or among populations with no previous exposure to OM chanting practices.

To address these limitations, future research should focus on several urgent priorities for clinical translation. Large-scale randomized controlled trials (RCTs) are necessary to establish causality and gauge long-term effectiveness. Investigating long-term effects and differences across various cultural contexts will be crucial. Expanding studies to include diverse populations and cross-cultural comparisons will yield broader insights essential for global applicability.

V. CONCLUSION AND SUMMARY

Over the four-month study period in Bengaluru, OM chanting was associated with significant neurophysiological and psychological benefits among 120 participants, including those with Alzheimer's Disease. EEG analyses revealed a 34.2% increase in alpha wave activity, an 85.4% improvement in the theta/beta ratio, and an 82.22% reduction in EEG variance, indicating enhanced relaxation, emotional regulation, and neural stability. Improvements were observed across all participant categories, with reductions in stress, anxiety, and behavioral disturbances, as well as enhanced attention and quality of life. While OM chanting is not a cure for Alzheimer's Disease and does not replace pharmacological treatment, the findings support its potential as an accessible, non-pharmacological intervention to improve well-being in diverse populations.

For clinicians considering incorporating OM chanting into practice, the study suggests several clinical take-home points: first, integrating OM chanting sessions of 15-20-minute OM chanting sessions can enhance emotional regulation and reduce stress, particularly in high-pressure environments such as corporate settings. Secondly, early morning sessions may maximize therapeutic benefits, aligning with traditional practices. Finally, training caregivers and facilitators to guide OM chanting can help incorporate it into dementia care routines, thereby complementing existing treatments.

Further research with larger, more diverse samples and longer follow-up periods is warranted to confirm and extend these results.

VI. FUTURE SCOPE

6.1 Longitudinal Studies

Large-scale, long-term randomized controlled trials are essential to determine whether OM chanting can slow cognitive decline or delay disease progression in AD. Studies should track participants over 6-12 months or longer, with regular assessments of cognitive function, behavioral symptoms, brain structure (via MRI), and biomarkers (amyloid, tau, neuroinflammation). Comparison with standard care and other non-pharmacological interventions would establish relative efficacy.

Advanced neuroimaging techniques (fMRI, PET, MEG) should be employed to identify specific brain

regions and networks affected by OM chanting in AD patients. Research should investigate whether OM chanting influences neuroplasticity, synaptic function, neurotransmitter systems, or inflammatory pathways. In addition to these imaging techniques, the use of specific biomarkers, such as cytokines, brain-derived neurotrophic factor (BDNF), and heart rate variability (HRV), could provide valuable mechanistic insights. These biomarkers may reveal inflammatory responses, neuronal growth and repair processes, and autonomic nervous system regulation induced of OM chanting. Studies examining effects on amyloid and tau pathology would be particularly valuable. Investigation of vagal nerve stimulation mechanisms and autonomic nervous system modulation could elucidate physiological pathways.

6.3 Optimization of Intervention Parameters

Research should determine optimal dosage (frequency, duration, session length), delivery methods (active chanting vs. passive listening, individual vs. group sessions), and timing (early vs. late-stage AD). Comparative studies with other meditation techniques, sound therapies, and music interventions would identify specific benefits of OM chanting. Personalization approaches based on individual characteristics, disease severity, and patient preferences should be explored.

6.4 Broader Population Studies

Expanded research should include diverse populations at different stages of AD severity, with diverse cultural backgrounds and demographic characteristics. Studies should examine the effects of mild cognitive impairment (MCI) to assess its potential for early intervention. Investigating the benefits of caregivers practicing alongside patients could address caregiver stress and improve relationship quality.

6.5 Implementation Science

Research on practical implementation in clinical settings, long-term care facilities, and home environments is needed. Development of standardized protocols, training programs for facilitators, and integration with existing dementia care programs would support clinical translation. Cost-effectiveness analyses comparing OM chanting to pharmacological and other non-pharmacological interventions would inform healthcare policy.

6.6 Advanced Analytical Approaches

Machine learning and artificial intelligence applications could identify predictive patterns in EEG data, predict treatment responders, and optimize intervention parameters. Network analysis techniques could elucidate changes in brain connectivity. Integration of multi-modal data (EEG, neuroimaging, biomarkers, clinical assessments) would provide a comprehensive understanding.ing.

6.7 Combination Therapies

Investigation of OM chanting combined with other interventions (cognitive training, physical exercise, pharmacotherapy) may reveal synergistic effects. Research on optimal integration within comprehensive dementia care programs would support holistic treatment approaches.

6.8 Post-Pandemic Mental Health Applications

Given the significant impact of COVID-19 on mental health and cognitive function globally, future research should specifically examine OM chanting's effectiveness for post-pandemic populations experiencing long COVID symptoms, pandemic-related anxiety, sleep disorders, and accelerated cognitive decline. Studies comparing pre-pandemic and post-pandemic populations could reveal whether OM chanting offers particular benefits for pandemic-related neuropsychiatric symptoms.

These research directions will facilitate the translation of OM chanting from an ancient spiritual practice into an evidence-based complementary therapy for Alzheimer's Disease, potentially improving the quality of life for millions of patients and caregivers worldwide while bridging traditional wisdom with modern neuroscience.

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