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BrainTap Technologies Technical Overview Version 10 - June 2025.

1. Disclaimer

All research and information published herein is for informational purposes only. Readers are encouraged to confirm or verify information contained herein with other sources. The present document consists of a technical overview of BrainTap Technologies and is not in any way intended to be a complete and definite review on the matter, recognizing that the underlying information may not be current, complete or exhaustive. We strive for accuracy and completeness to support our opinions, however all information is presented "as is" without warranty of any kind – express or implied.

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2. Introduction - Audio-Visual Brain Entrainment

Human brain waves, measured by an electroencephalogram (EEG), are rhythmic or repetitive patterns of neural activity in Central Nervous System (CNS) neurons. It is through these electrical signals that the brain communicates within itself and with other organ systems (Abhang et al., 2016). Coherent and functional brainwave patterns are required for the successful processing, execution, and completion of a task, whether physical (such as walking) or mental (solving an algebra problem, for instance) (Tang et al., 2016).

It is well known that brain oscillatory rhythms that fall in the 1-30Hz frequency range can be modulated or entrained by an external stimulus (Thut et al., 2011). More specifically, entrainment occurs if a population of neurons in a stimulated region adopts the phase of an entraining stimulus. The entraining stimulus has two effects on population activity: (i) an increase in signal intensity (or power) as more and more neurons become phase aligned to the entraining stimulus, and (ii) phase alignment of the population activity to the entraining stimulus (Hanslmayr et al., 2019).

In healthy individuals, specific brainwave patterns are associated with various mental states. Five common brainwave frequency bands or patterns (delta, theta, alpha, beta, and gamma) and related mental activities have been described (Abhang et al., 2016). Brainwave or Neural entrainment may provide an increase in power of the stimulated oscillatory frequency (Chaieb et al., 2015), and can be achieved with minimal effort from the participant through rhythmic auditory (Isochronic tones, Binaural beats) or visual stimulation to entrain neural oscillations.

As reviewed by Tang et al. (2016), the development of Audiovisual Brain Entrainment (AVBE), also known as Audio-Visual Neurostimulation (AVN), originated from early observations of light's effects on human perception and physiology. One of the earliest accounts dates back to 125 A.D., when Apuleius noted that flickering light produced by a potter's wheel could trigger physical responses resembling epileptic symptoms. In the early 20th century, psychologist Pierre Janet observed that flickering lights from a rotating wheel in front of a paraffin lamp appeared to reduce psychological strain in his patients. With the advent of electroencephalography (EEG), researchers such as Adrian and Matthews began to systematically study the influence of photic stimulation on brain activity. A major milestone occurred in 1949 when W. Gray Walter demonstrated that flickering light stimulation could alter not only visual cortex activity but also evoke widespread changes across the entire cortex, accompanied by distinct sensory experiences. His documentation of this "flickering phenomenon" is considered foundational in the scientific literature on audiovisual stimulation. Photic stimulation uses rhythmic visual stimuli—such as flashing or pulsing lights delivered through specially designed glasses—to entrain brainwave activity. By adjusting the flickering frequency, color (wavelength), and luminance intensity of the lights, this technique can induce synchronization of brainwaves with the external stimuli (Park et al., 2022). Although visual entrainment primarily targets the primary visual cortex in the occipital lobe, studies have shown that it can also produce widespread changes in cortical activity. When combined with auditory stimuli, the entrainment effect may be further enhanced.

Until 1960, researchers focused primarily on the influence of optical stimulation on brain activity. Beginning in 1960, a study by Gian Emilio Chatrian reported changes in brainwave voltage potential in response to auditory stimulation (clicking sounds), regardless of visual input (Chatrian et al. 1960). Then, in 1973, Oster's research on binaural beats advanced the understanding of acoustic stimulation (Oster, 1973). These are considered the beginning of auditory brain entrainment stimulation through isochronic tones and binaural beats.

Isochronic tones are characterized by evenly spaced intervals of sound, creating a rhythmic beat with a frequency determined by the length of these intervals. Like monaural tones, isochronic tones are combined into a cohesive auditory experience before reaching the ear (Engelbregt et al., 2019). The frequency-following response (FFR) is an auditory evoked potential that mirrors the periodic characteristics of a sound stimulus, reflecting the brain's ability to track and encode frequency information over time (López-Caballero et al. 2020).

Binaural beats, on the other hand, represent the auditory experience of an oscillating sound that occurs when two sounds with neighboring frequencies are presented to one's left and right ear separately. This procedure produces a third phantom beat, whose frequency is equal to the difference of the two presented tones and which can be manipulated for non-invasive brain stimulation (Beauchene et al., 2016). For example, when a 400 Hz sound frequency is delivered to the left ear, while a 405 Hz is delivered to the right ear, the brain processes and interprets the two frequencies as a 5 Hz frequency. Frequency following response (FFR) occurs at the 5Hz frequency, producing brainwaves at the same rate of 5 Hz (Brain Entrainment), which can be used to "modulate" brainwave activity.

Although the exact underlying mechanisms are not well understood, audio-visual brainwave entrainment has been associated in the literature with potential benefits, such as enhanced cognitive performance (Derner et al., 2018; Colzato et al., 2017; Hommel et al., 2016; Chaieb et al., 2015; Reedijk et al., 2013; Huang & Charyton, 2008), reductions in perceived stress and anxiety (Garcia-Argibay et al., 2019; Chaieb et al., 2017; Wahbeh et al., 2007b; Padmanabhan et al., 2005; Le Scouarnec et al., 2001); improvements in psychomotor performance and mood (Lane et al., 1998; Wahbeh et al., 2007); better sleep quality (Tang et al., 2015; Abeln et al., 2014); and potential modulation of pain perception and support for analgesic effects (Ecsy et al., 2018; Ecsy et al., 2017; Ecsy 2014; Garcia-Argibay et al., 2019; Ecsy et al., 2017; Zampi, 2016).

3. BrainTap Research Data

3.1. Studies - Design Principles

The studies with BrainTap Technologies outlined below were conducted in accordance with the following principals:

- Pilot clinical trial;
- Randomized;
- Sample size large enough to allow for statistical significance (95% confidence interval and a *P value* ≤ 0.05).

3.2. Primary Research Outcomes

- **Heart Rate Variability**: In a sample of 100 adult volunteers, a single BrainTap session was associated with significant increases in heart rate variability and parasympathetic activity, along with reductions in heart rate and stress index. (Study #1 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849).
- **Sleep Quality in Students**: University students who engaged in BrainTap sessions three times per week for six weeks reported statistically significant improvements in sleep quality. (Study #2 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849).
- **Telemarketers' Well-Being**: In an observational study, BrainTap sessions were associated with positive trends in self-reported anxiety, general health, stress, sleep, productivity, and activity impairment, though results did not reach statistical significance. (Study #3 - Presented at the International Society for Neuroregulation & Research 2020 online Conference - ISNR-2020).
- **Cognitive-Emotional Enhancement**: When combined with Dr. Kelly Miller's "Saving Your Brain" program, BrainTap was linked to improvements in Quantitative Electroencephalogram (QEEG) analysis and cognitive-emotional assessments. (Study #4 - Presented at the International Lyme and Associated Diseases Society 22nd Scientific Conference. Orlando FL, OCT 2021 - ILADS 2021).

- **<u>Brainwave Modulation in Athletes</u>**: Among college golfers, a single session combining BrainTap and transcranial Photobiomodulation (tPBM) was associated with increased alpha and decreased gamma brainwave activity, indicating a potential neuromodulatory effect. (Study #5 - Accepted at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 - ICIMH-2022).
- **<u>Sleep Support in Dayworkers</u>**: Preliminary data suggest that BrainTap sessions during the daytime may support improvements in sleep-related symptoms among adult dayworkers with normal sleep duration (Study #6 - Accepted at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 - ICIMH-2022).
- **<u>Weight and Stress Trends:</u>** Daily BWE sessions were associated with reductions in stress and weight, although data was not statistically significant (Study #7 - PhD Thesis in the 2021 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA).
- **<u>Health Behavior Program Outcomes</u>**: In a 13-week wellness program combining BrainTap with lifestyle coaching, participants showed statistically significant improvements in mood, stress, anxiety, and weight management. (Study #8 - PhD Thesis in the 2022 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA).
- **<u>Professional Performance</u>**: BrainTap combined with the Peak Performance Method (PPM) was associated with improved scores in anxiety, mindset, stress, productivity, sleep quality, and general wellness among professionals. (Study #9 - Conducted with Julia Arndt (the Peak Performance Method creator - Conducted Online in 2020).
- **<u>Post-Concussion Wellness:</u>** In a school-based case series, combining BrainTap with compression therapy appeared to reduce lingering post-concussion symptoms in high school athletes, particularly over longer-term follow-up. (Study #10 - Study conducted by Dr. Arkfeld at the Gaylord High School in Gaylord, MI, United States. 2020-2021).
- **<u>General Well-Being</u>**: BrainTap use was associated with improvements in mood, stress levels, sleep quality, and energy in an internal observational study. (Study #11 - Internal study conducted with BioStrap & BrainTap team members. Conducted online in 2021).
- **<u>Resilience in Major Depression Disorder</u>**: In a study involving individuals with Major Depressive Disorder, BrainTap combined with a Mediterranean diet was associated with greater improvements in resilience and quality-of-life scores

compared to diet alone. (Study #12 – PhD Thesis conducted in the Laboratory of Experimental Neurosciences [LaNEX] at the University of Southern Santa Catarina, SC, Brazil. Preliminary data was selected for Special session poster presentation at the Ganepão Congress, SP, Brazil, July of 2024).

- **Brainwave Activity in Fibromyalgia:** Eight weeks of BWE sessions were associated with increased comfort, reduced emotional limitations, and increased Alpha wave activity in the left and right Prefrontal Cortex in patients diagnosed with Fibromyalgia. (Study #13 –Conducted at the Physiotherapy School Clinic and the Medical Specialty Clinic (AMEI) of the University of Southern Santa Catarina, SC, Brazil).
- **Acoustic Neurostimulation**: A study found that BrainTap's alpha-frequency entrainment (10 Hz) may help support reductions in perceived stress, anxiety, and depressive symptoms, suggesting a role in emotional well-being. (Study #14 – PhD Thesis, conducted at the Federal University of Santa Catarina SC, Brazil. Published at the Exploration of Neuroprotective Therapy journal. 2023;3:481-96)
- **EMF Technology and Wellness**: A pilot internal study combining BrainTap and Somavedic EMF reduction devices reported trends toward improved sleep, stress, mood, and depression scores, though anxiety symptoms reductions were not statistically significant. (Study #15 – Internal study with BioStrap & Somavedic team members conducted online in 2021).
- **Fibromyalgia Management**: In a study with 84 women diagnosed with fibromyalgia, BrainTap was associated with increased comfort, improved quality of life, and changes in oxidative stress and BDNF biomarkers. (Study #16 - PhD thesis conducted in the Laboratory of Experimental Neurosciences [LaNEX] at the University of Southern Santa Catarina, SC, Brazil. Presented virtually at the 3d International Conference on Cognitive and Behavioral Neurosciences Sep 13-14, 2023 at Barcelona, Spain).
- **Autonomic Balance and PFC Hemodynamics**: A study involving university health students found that a single 20-minute session of BWE with alpha waves using the BrainTap Headset was associated with improved heart rate variability, reduced cerebral blood flow in the Prefrontal Cortex, and balanced autonomic activity. These results suggest potential benefits for mental well-being. (Study #17 - Conducted in the Laboratory of Experimental Neurosciences [LaNEX] at the University of Southern Santa Catarina, SC, Brazil. Presented at the 2nd world Congress Integrative Medicine and Health in Rome at the Workshop Integration of Brainwave Entrainment and Electroacupuncture: Effects on Frontal Cortex Hemodynamics and Autonomic Balance [September 2023]).

- **<u>Sleep and Recovery in Flight Crews:</u>** Among international pilots and flight attendants, BrainTap sessions during travel recovery were associated with improvements in sleep quality, morning alertness, and overall well-being. (Study #18 – Master's Dissertation from the postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA).
- **<u>Alpha Brainwave Enhancement:</u>** Real-time EEG recordings showed that a single 20-minute BrainTap session significantly increased alpha power, especially in occipital and right frontal regions, with large effect sizes observed. (Study #19 – Study conducted at the Sri Sri Neuro Centre, Warangal, Telangana, India).
- **<u>Autonomic Regulation and Brainwaves:</u>** BrainTap combined with guided breathing significantly influenced EEG patterns and HRV, suggesting improved autonomic regulation and focused relaxation. (Study #20 - Published at Cadernos de Naturololgia e Terapias Complementares, Volume 12, number 21, 2023).
- **<u>Relaxation and Autonomic Balance</u>:** In a crossover pilot study with 15 adults, BrainTap sessions—especially without vibration—showed significant improvements in HRV metrics and self-reported well-being. (Study #21 – Conducted at the Seminole State College, Florida, USA)
- **<u>Special Forces Stress and Sleep</u>:** In a 3-week pilot with 22 special forces soldiers, daily BrainTap sessions were associated with significant reductions in stress symptoms and improved sleep quality, with medium effect sizes reported. (Study #22– Conducted with Special Forces)
- **<u>Wellness in Healthcare Students</u>:** A 12-week study with healthcare students showed that daily auditory BrainTap sessions significantly improved self-reported sleep, reduced stress, lowered anxiety, and enhanced mood. (Study #23 – Conducted at the Seminole State College, Florida, USA. Published at the Revista Mexicana de Neurociência. 2025;26(1):5-13)
- **<u>Brainwave Entrainment Review:</u>** A systematic review of 33 randomized controlled trials found that auditory brainwave entrainment using binaural beats and isochronic tones was associated with positive trends in mood, attention, and memory. Some studies also reported exploratory findings in individuals with conditions such as ADHD, anxiety, and chronic pain; however, further research with rigorous study designs is needed to confirm these observations. (Study #24 – Review study. Published at the Revista Mexicana de Neurociência. 2021;22(6):238-247)
- **<u>Brainwave Entrainment and Well-Being:</u>** An integrative review of 84 studies reported that auditory and visual brainwave entrainment was associated with positive trends in sleep quality, mood, cognitive function, and pain perception. Several studies also explored potential applications in neurodegenerative and mental health conditions, though further high-quality research is needed to validate

these findings and better understand the mechanisms involved. (Study #25 – Review study. Published at the Applied Psychophysiology and Biofeedback journal. 2025;50:3-9)

Disclaimer: *The findings described above are based on exploratory, pilot, academic, and observational studies. These statements have not been evaluated by the U.S. Food and Drug Administration (FDA). BrainTap is not intended to diagnose, treat, cure, or prevent any disease. The information presented is for educational purposes only and does not substitute for professional medical advice, diagnosis, or treatment.*

4. Frequently Asked Questions

4.1 What is the BrainTap headset?

The BrainTap headset is a wellness device designed to support relaxation and mental clarity. It uses gentle pulses of light through special earphones and a visor, synchronized with sound (binaural beats and isochronic tones). This combination is designed to help guide users toward deeper states of relaxation. While individual experiences may vary, some users report that these sessions promote a sense of calm and focus.

The BrainTap headset is driven by guided audio sessions encoded with Neuro-Sensory Algorithms (NSAs), designed to help guide brainwave activity. A minicomputer inside the BrainTap headset converts the NSA encoded signal embedded within each session, thus guiding the user through the brainwave entrainment process designed specifically for that session.

With nearly 700 sessions in more than 50 categories, the BrainTap headset system works with any smartphone or tablet that can operate Apple or Android apps.

4.2 What is brainwave entrainment?

Brainwave entrainment is the process of guiding the brain's rhythms to follow specific external frequencies. BrainTap sessions use light and sound to help support relaxed and focused brainwave patterns. Visualization and guided imagery techniques—commonly used in wellness and creative practices—are incorporated to enhance the immersive experience.

4.3 What are brainwave frequencies, and what do they mean?

Brainwave frequencies are patterns of electrical activity in the brain, measured in hertz (Hz). Different frequency ranges are associated with different mental and emotional states, from active concentration to deep sleep.

The BrainTap system is designed to support shifts in brainwave activity by helping reduce dominant high-frequency beta activity (often linked to stress and overthinking) and encouraging more calming alpha and theta patterns. This shift may support the body's natural relaxation response, which is difficult to access during high-stress states.

Here's a brief overview of the primary brainwave frequencies:

- BETA (13–30 Hz): The active, alert state most associated with problem-solving, logic, and focused mental activity. High levels of beta activity can be linked to stress and anxious thinking.
- ALPHA (8–13 Hz): Associated with calm focus, creativity, daydreaming, and relaxed alertness. Alpha waves are often present during meditation and quiet reflection.
- THETA (4–8 Hz): A slower, dreamlike state associated with deep meditation, creativity, and insight. This state is often experienced just before sleep and can support imaginative thinking and emotional processing.
- DELTA (1–4 Hz): The slowest brainwave state, typically present during deep, dreamless sleep. While delta is important for physical restoration, BrainTap is designed to keep users relaxed but not fully asleep, so light and sound patterns shift to avoid full delta immersion.

BrainTap uses sound and light to help guide the brain toward these frequencies. Individual responses may vary, and the experience is not intended to diagnose or treat any medical or psychological condition.

4.4 What is frequency following response?

The frequency following response (FFR) is the brain's tendency to synchronize with rhythmic stimuli like sound or light pulses. BrainTap uses this effect to help guide users into relaxed brainwave states. Some users report feeling calmer and more focused after repeated sessions, though individual responses vary.

4.5 What are binaural beats?

Binaural beats are auditory illusions created by presenting two slightly different frequencies in each ear. The brain perceives a third "phantom" frequency, which may support relaxed brainwave states. Research has explored binaural beats for relaxation and focus, though effects can vary from person to person.

4.6 What are isochronic tones?

This is the newest brainwave entrainment technology. Isochronic tones are manually created, equal intensity pulses of sound separated by an interval of silence. They turn on and off rapidly, but the speed depends on the desired brain frequency. The discrete nature of isochronic tones makes them particularly easy for the brain to follow.

4.7 Why are there lights in the earphones?

The earphone lights emit pulses of light at specific frequencies. These are designed to stimulate auricular points gently and may help enhance the relaxation experience. The light intensity is low and generally not visible to the human eye.

4.8 How important are the music and tones?

Brainwave entrainment is often enhanced through both auditory and visual stimulation. Environmental sounds and music have been used across cultures for centuries to support relaxation and meditative states. For example, natural sounds like ocean waves or rainfall are commonly associated with calmness and may encourage relaxed brainwave patterns such as alpha activity.

Because people today may not always have access to such natural environments, BrainTap incorporates music and tones designed to help recreate a similarly immersive experience. Dr. Porter has composed and encoded each session to synchronize with audio-guided visualization and brainwave entrainment goals.

The music used in BrainTap sessions is specifically selected to complement the auditory aspects of alpha and theta brainwave guidance. It aims to enhance the overall experience and help support focus, relaxation, and mental imagery. Individual responses to music and tones may vary.

4.9 Why are LED's used instead of incandescent lights?

Light emitting diodes, also called LEDs, are solid-state devices that convert small amounts of safe electrical energy into light. They can be switched on and off much faster than incandescent lights, producing the crisp strobe-like pulses most effective at inducing the frequency following response needed to guide the user through the brainwave states. For BrainTap, blue LEDs were chosen for their pure, cool, calming color. Our operational research showed that users preferred the blue effect through closed eyes more than any other LEDs available. It is important to note that a person who is prone to seizures should not use the light portion of the BrainTap headset system.

4.10 Are the audio sessions effective without the Braintap headset?

Visualization and guided imagery techniques have been used for decades to support stress reduction, behavior change, and personal development. These techniques are widely incorporated into wellness and self-improvement programs. BrainTap enhances these experiences with the additional support of auditory and visual brainwave entrainment.

While many relaxation methods—such as autogenic training, progressive relaxation, meditation, and biofeedback—require conscious effort and practice, the BrainTap system is designed to offer a more immersive experience. Users can simply relax and engage with the audio-guided session. Individual results may vary.

4.11 Why are there sometimes two voices on the Braintap audios?

This technique, known as “Dual Voice Processing,” is designed to stimulate both hemispheres of the brain. One voice may shift from side to side in the headphones. You don’t need to focus on the voices—just relax and let the experience unfold. The sessions that have Dual Voice Processing are marked “DV” and those that don’t will be marked “SV” for single voice.

4.12 What happens during a Braintap session?

You wear the headset over your eyes and ears while listening to a guided audio session. The system uses light and sound patterns to gently support transitions through various brainwave states. Some users report feeling relaxed, experiencing visual patterns, or feeling deeply calm. Effects vary.

4.13 What is it like to experience Braintap?

Many users describe the experience as deeply relaxing—like the body falling asleep while the mind stays aware. These sessions help support mental rehearsal of positive intentions. BrainTap does not guarantee behavior change, but some users find it helpful for reinforcing their wellness goals.

4.14 What are the benefits of using the Braintap headset?

The BrainTap headset is intended to support:

- Deep relaxation and a sense of calm
- Focus and concentration
- Reduced perception of stress
- Healthy sleep habits
- Motivation and mental clarity

User-reported outcomes include improved memory, sleep, and energy. Results vary. BrainTap is not a treatment for any medical condition.

4.15 How does Braintap produce these results?

BrainTap sessions aim to help users enter brainwave states associated with focus and calm. The technology is designed to enhance awareness of existing personal abilities and promote mindful habits. As with any wellness tool, results depend on consistent use and individual factors.

4.16 How soon will I notice results?

Some users report immediate effects such as feeling refreshed or energized. Others may experience benefits over time. BrainTap recommends using the full session series for best results. Keep in mind that outcomes vary by individual.

4.17 How will I know I've reached alpha or theta?

Users may feel lightness, heaviness, warmth, or a drifting sensation. Others experience vivid images or geometric patterns. These sensations may indicate your brain is transitioning toward the relaxed alpha or theta states. Experiences vary widely and are not guaranteed.

4.18 Is it safe?

BrainTap is generally well-tolerated. However, individuals with epilepsy, light sensitivity, seizure disorders, or neurological conditions should consult their doctor before use. Side effects are rare but may include mild dizziness or visual sensitivity.

4.19 Who can benefit from Braintap technology?

BrainTap is designed for adults and children who are not sensitive to light and sound stimulation. Those with diagnosed light sensitivity or seizure disorders should avoid the flashing light component and may use the audio sessions only, with guidance from a medical professional.

4.20 Can everyone use the Braintap headset?

While most people can use the BrainTap system, it is not recommended for individuals with serious psychiatric or neurological conditions unless approved by a healthcare provider. Always consult a doctor if you have medical concerns.

4.21 Can children use the Braintap headset?

Children may use the BrainTap system under adult supervision. Sessions should be age-appropriate, and parents should monitor usage. If the child has any medical or sensory issues, consult a pediatrician before use. The headset should never be used unsupervised.

Disclaimer*: BrainTap is a wellness device and is not intended to diagnose, treat, cure, or prevent any disease or medical condition. The content presented in these FAQs is for informational purposes only and reflects user experiences and scientific theories. Individual results may vary. Consult a healthcare professional before beginning any new wellness program, especially if you have a medical or mental health condition.*

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6. Annex List

- Study #1 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849.
- Study #2 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849.
- Study #3 - Presented at the International Society for Neuroregulation & Research 2020 online Conference - ISNR-2020.
- Study #4 - Presented at the International Lyme and Associated Diseases Society 22nd Scientific Conference. Orlando FL, OCT 2021 - ILADS 2021.
- Study #5 - Presented at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 - ICIMH-2022.
- Study #6 - Presented at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 - ICIMH-2022.
- Study #7 - PhD Thesis in the 2021 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.
- Study #8 - PhD Thesis in the 2022 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.
- Study #9 - Conducted with Julia Arndt (the Peak Performance Method creator - Conducted Online in 2020.
- Study #10 - Study conducted by Dr. Arkfeld at the Gaylord High School in Gaylord, MI, United States. 2020-2021.
- Study #11 - Internal study conducted with BioStrap & BrainTap team members. Conducted Online in 2021.
- Study #12 – PhD Thesis in the postgraduate Program in Health Sciences, Laboratory of Experimental Neurosciences (LaNEX) of the University of South Santa Catarina, SC, Brazil. Preliminary data was selected for Special session poster presentation at the Ganepão Congress, SP, Brazil, July of 2024.
- Study #13 – Master's degree dissertation in the postgraduate Program in Health Sciences of the University of Southern Santa Catarina, SC, Brazil. Conducted at the Physiotherapy School Clinic and the Medical Specialty Clinic (AMEI) of the University of Southern Santa Catarina, SC, Brazil.

- Study #14 – PhD Thesis, conducted at the Federal University of Santa Catarina SC, Brazil. Published at the Exploration of Neuroprotective Therapy journal. 2023;3:481-96. doi:10.37349/ent.2023.00064
- Study #15 - Internal study conducted with BioStrap & Somavedic team members. Conducted Online in 2021).
- Study #16 - PhD thesis of the Post Graduate Program in Health Sciences at the University of Southern Santa Catarina, SC, Brazil. Presented virtually at the 3d International Conference on Cognitive and Behavioral Neurosciences (Sep 13-14, 2023 at Barcelona, Spain).
- Study #17 - Conducted in the Laboratory of Experimental Neurosciences (LaNEX) at the University of Southern Santa Catarina (UNISUL), Brazil. Presented at the 2nd world Congress Integrative Medicine and Health in Rome at the Workshop Integration of Brainwave Entrainment and Electroacupuncture: Effects on Frontal Cortex Hemodynamics and Autonomic Balance (September 21 of 2023).
- Study #18 – Master's Dissertation from the postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.
- Study #19 – Study conducted at the Sri Sri Neuro Centre, Warangal, Telangana, India.
- Study #20 – Study conducted at the All India Institute of Medical Sciences (AIIMS), Bhopal, India. Published at Cadernos de Naturololgia e Terapias Complementares, Volume 12, number 21, 2023.
- Study #21 – Study conducted at the Seminole State College, Florida, USA.
- Study #22 - Conducted with Special Forces Soldiers.
- Study #23 – Conducted at the Seminole State College, Florida, USA. Published at the Revista Mexicana de Neurociência. 2025;26(1):5-13. doi: 10.24875/RMN.24000024
- Study #24 – Review study. Published at the Revista Mexicana de Neurociência. 2021;22(6):238-247. doi:10.24875/RMN.20000100
- Study #25 – Review study. Published at the Applied Psychophysiology and Biofeedback journal. 2025;50:3-9. doi:10.1007/s10484-024-09682-x

BrainTap Technologies Technical Overview Version 10.0 – June 2025.

Anex List

Study #1 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849.

Effect of a single Audio-Visual Brain Entrainment session on Heart Rate Variability: a clinical trial with 100 adult volunteers

Michael Porter[1], Patrick Porter[1,2], Francisco J Cidral-Filho[1]

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2. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.

Objective
The objective of this study was to investigate the effect of the Audio-Visual Brain Entrainment (ABE) on Heart Rate Variability.

Methods
Sample size consisted of 100 adult volunteers (50 males and 50 females) with no hearing disabilities. ABE was delivered with a BrainTap headset (New Bern - NC - USA) in a 20-minute session. Session consists of Binaural beats at 18 to 0.5 HZ, Isochronic Tones at 18 to .0.5 HZ and visual Entrainment through light-emitting diode lights at 470 nanometers (nm) flickering at 18 to 0.5 HZ. Heart rate Variability (Dinamika HRV - Advanced Heart Rate Variability Test System, Moscow, Russia) was assessed at baseline and after ABE session.

Results
ABE significantly (1) increased Heart Rate Variability: HRV Index (A low HRV is associated with an increased risk of cardiovascular disease - $p<0.001$, 21.8%) and RRNN (RR normal-to-normal intervals; a marker of overall HRV activity - $p<0.001$, 6.8%); (2) increased Parasympathetic activity markers: RMSSD (Root Mean Square of the Successive RR interval Differences - $p<0.0001$, 32.2%), NN50 (The number of pairs of successive NN (R-R) intervals that differ by more than 50 ms - $p<0.0001$, 50.6%), pNN50% (The proportion of NN50 divided by the total number of NN (R-R) intervals - $p<0.001$, 51.6%), HFnu (High Frequency Band: index of modulation of the parasympathetic branch of the autonomic nervous system - $p<0.0336$, 37.1%), and LFnu: (Low Frequency Band: general indicator of aggregate modulation of both the sympathetic and parasympathetic branches of the Autonomic Nervous System - $p<0.0048$, 45.1%); and (3) decreased Stress Index ($p<0.001$, 38.4%) and Heart Rate ($p<0.0001$, 6.2%).

Conclusion
A single Audio-Visual Brain Entrainment session with the BrainTap Headset significantly increased heart rate variability and parasympathetic activity, as well as decreased stress index and heart rate.

Figures

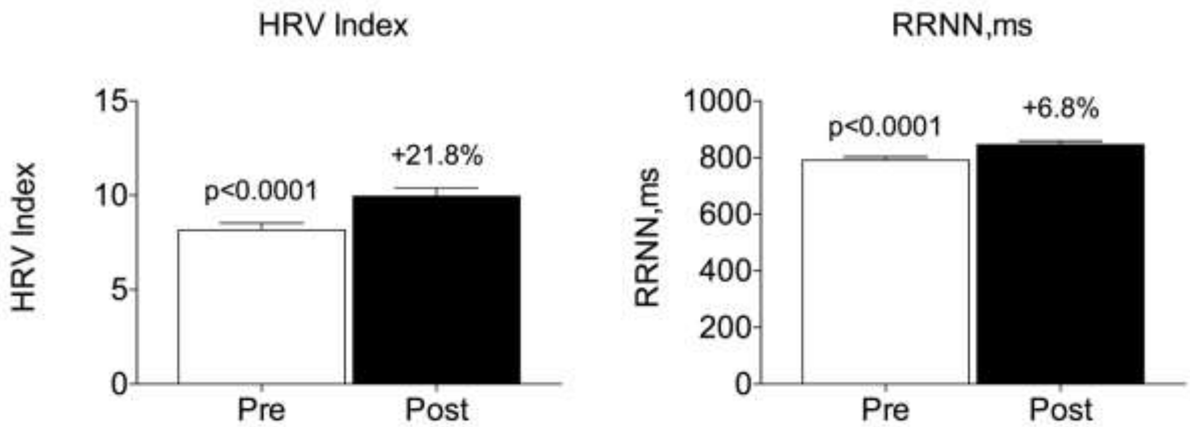

Figure 1 - Effects of ABE on Heart Rate Variability Index and RRNN (RR normal-to-normal intervals; a marker of overall HRV activity). Paired T-Test 95% with a confidence interval (Graphpad Prism software, USA).

Study #2 - Presented at the International Congress on Integrative Medicine and Health in Miami, FL, May 2020 (ICIMH-2020). Published at Global Advances in Health and Medicine Volume 9, 2020. DOI: 10.1177/2164956120912849.

Effect of Audio-Visual Brain Entrainment on Mood and Quality of Sleep: a pilot trial with university students

Daiana Cristina Salm[1,2], Luiz Augusto Belmonte[1,2], Bruna Hoffmann de Oliveira[1,2], Luana Meneghini Belmonte[1,2], Francisco J Cidral-Filho[1,2], Patrick Porter[3] and Daniel Fernandes Martins[1,2]

1. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.
2. Postgraduate Program in Health Sciences, University of Southern Santa Catarina, SC, Brazil.
3. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.

Objective
The Study Objective was to investigate the effect of the Audio-Visual Brain Entrainment (ABE) on Mood and Quality of Sleep of university students.

Methods
The study was conducted at the Laboratory of Experimental Neurosciences (LaNEX) at the University of Southern Santa Catarina (UNISUL), Brazil, and the protocol was approved by the Institutions Ethics committee. Informed consent forms were obtained during patient screening phase of the study at the site of the tests.
Sample size consisted of 7 university students (Four males and three females. Ages between 20 and 58), who were not making use of analgesics, anti-inflammatories or sleep aids 7 (seven) days prior to, as well as during the study, and who had no hearing disabilities. ABE was delivered with a BrainTap headset (New Bern - NC – USA; Figure 1, A & B) in 20-minute sessions 3 times a week for 6 weeks. Session consists of Binaural beats at 18 to 0.5 HZ, Isochronic Tones at 18 to .0.5 HZ and visual Entrainment through light- emitting diode lights at 470 nanometers (nm) flickering at 18 to 0.5 HZ. The following questionnaires were applied at baseline and after 6 weeks: Epworth Sleepiness Scale - Daytime sleepiness (ESS), Insomnia Severity Index (ISI), Pittsburgh Quality of Sleep Index (PQSI), Depression Anxiety and Stress Scale (DASS-21), and Perceived Stress Scale (EPS-10).

Results
ABE effectively reduced ISI (data not statistically significant); PQSI ($p<0.05$); DASS-21 (data not statistically significant); and EPS-10 (data not statistically significant). The participants reported feeling very relaxed during the sessions.

Conclusion

Despite the reduced sample size (n=7), results indicate that Audio-Visual Brain Entrainment (ABE) significantly increased Quality of Sleep of university students (PQSI p<0.05).

Figures

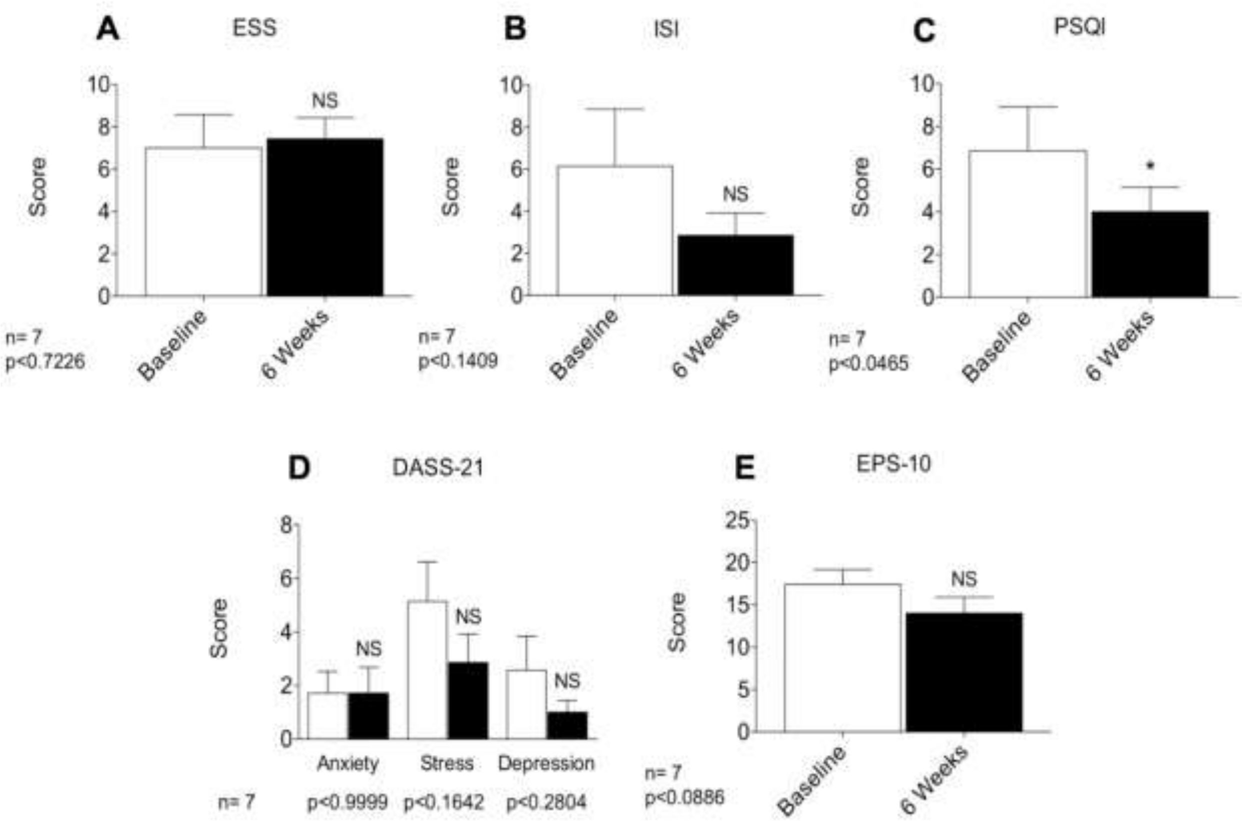

Figure 1 - Effect of Audio-Visual Brain Entrainment on Mood and Quality of Sleep. A) Epworth Sleepiness Scale; B) Insomnia Severity Index; C) Pittsburgh Quality of Sleep Index; D) Depression Anxiety and Stress Scale; E) Perceived Stress Scale. Data were expressed as mean ± standard deviation (SD) n = 7. Student's T-test was used. *p<0.05 when compared with baseline evaluation. NS: not statistically significant.

Study #3 - Presented at the International Society for Neuroregulation & Research 2020 online Conference (ISNR-2020).

Effect of Audio-Visual Brain Entrainment on Mood, Sleep and Work Productivity of Professional Telemarketers

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2. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
3. Residence Program in Manipulative, Complementary and Integrative Physical Therapy, Philadelphia University Center, PR, Brazil.
4. PostureLab, Paris France.
5. Health Sciences Program, Santa Casa de São Paulo School of Medical Sciences, SP, Brazil.

Background
Audio Visual Brainwave entrainment (ABE) occurs when brainwaves synchronize to external rhythmic stimuli, e.g, visual (flickering lights), auditory (Isochronic tones, and/or Binaural beats) or physical (physical vibration).

Objective
The objective of this study was to investigate the effect of the Audio-Visual Brain Entrainment (ABE) on Anxiety, General Health, Stress, Quality of Sleep and Work productivity and Activity Impairment of telemarketers.

Methods
The study was conducted at the Salgado Institute of Integrative Health, Londrina, PR - Brazil, and the protocol was approved by the Institutions Ethics Committee. Sample size consisted of 13 telemarketers (3 males and 10 females). ABE was delivered with a BrainTap headset (New Bern - NC - USA) in 20-minute sessions 3 times a week for 6 weeks. Session consists of Binaural beats (18 to 0.5 HZ), Isochronic Tones (18 to 0.5 HZ) and visual Entrainment (470 nanometers LEDs flickering at 18 to 0.5 HZ). The following questionnaires were applied at baseline and after 6 weeks: The Hamilton Anxiety Rating Scale (HAM-A) that measures the severity of anxiety symptoms; the General Health Questionnaire (GHQ-12), a screening device for identifying minor psychiatric disorders; the Perceived Stress Scale (PSS-10), the most widely used psychological instrument for measuring the perception of stress; the Pittsburgh Quality of Sleep Index (PQSI), that scores sleep quality; and the Work Productivity and Activity Impairment Questionnaire (WPAI), that measures impairments in work and activities.

Results

ABE positively affected all scores: HAM-A (22.95%); GHQ-12 (10.93%); PSS-10 (16.86%); PQSI (14.51%); as well as WPAI (absenteeism, 41.66%; presenteeism, 56.25%; work productivity, 56.22%; and activity Impairment due to health, 76%).

Conclusion

Although results did not achieve statistical significant when compared to baseline, ABE positively affect scores related to anxiety, general health, stress, quality of sleep, as well as work productivity and activity impairment of telemarketers.

Figures

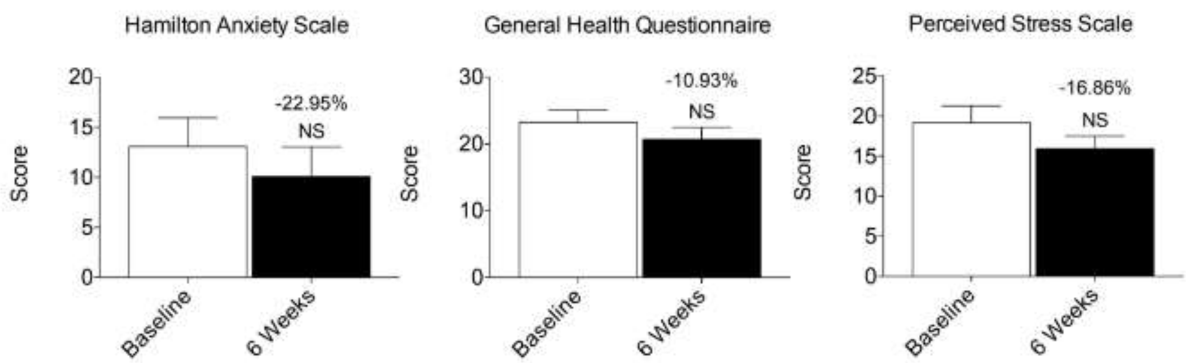

Figure 1 - The Effect of Audio-Visual Brain Entrainment on the Hamilton Anxiety Rating Scale (HAM-A), the General Health Questionnaire (GHQ-12), and the Perceived Stress Scale (PSS-10). NS: Not statistically significant (Paired T-Test with a 95% with a confidence interval - Graphpad Prism software, v.8, La Jolla, CA, USA).

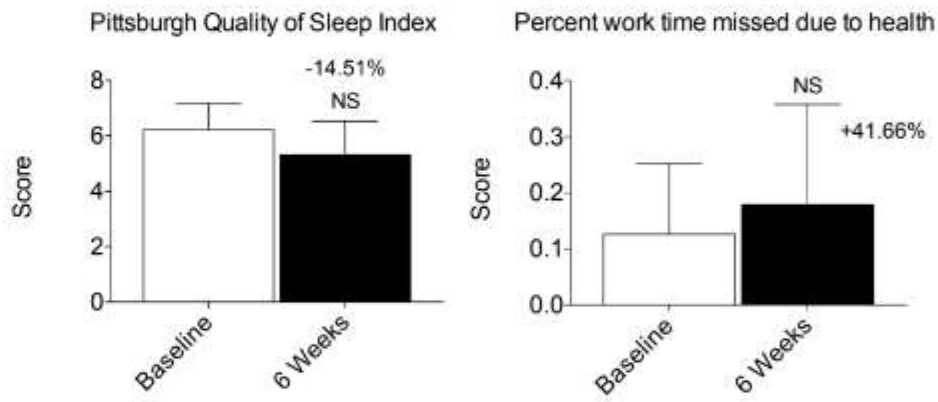

Figure 2 - The Effect of Audio-Visual Brain Entrainment on the Pittsburgh Quality of Sleep Index (PQSI), and the Work Productivity and Activity Impairment Questionnaire (WPAI). NS: Not statistically significant (Paired T-Test with a 95% with a confidence interval - Graphpad Prism software, v.8, La Jolla, CA, USA).

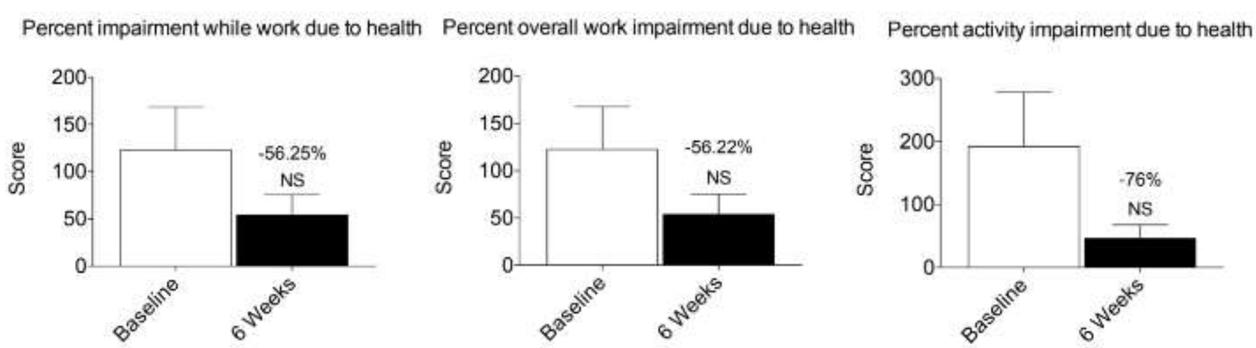

Figure 3 - The Effect of Audio-Visual Brain Entrainment on the Work Productivity and Activity Impairment Questionnaire (WPAI). NS: Not statistically significant (Paired T-Test with a 95% with a confidence interval - Graphpad Prism software, v.8, La Jolla, CA, USA).

Study #4 - Presented at the International Lyme and Associated Diseases Society 22nd Scientific Conference. Orlando FL, OCT 2021. (ILADS 2021).

Audiovisual Brain Entrainment associated with "Saving your Brain" therapeutic approach on Quantitative Electroencephalogram Analysis and Cognitive and Emotional Checklist Assessment.

Cidral-Filho, F.J.[1]; Porter, P.[2], Miller, K[2].

1. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.
2. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.

Objective

The objective of this study was to investigate the effect of Audio-Visual Brainwave Entrainment (ABE) associated with "Saving your Brain" therapeutic approach on Quantitative Electroencephalogram (QEEG) Analysis and the Cognitive and Emotional Checklist Assessment.

Methods

Participants (n=6, 5 female, 1 male, average of 61.3 years old) underwent approximately 6 weeks of therapy, i.e., three daily ABE sessions with the BrainTap headset (New Bern - NC - USA) associated with "Saving your Brain" therapeutic approach. The study was conducted at Dr. Kelly Miller's Clinic, Tampa, FL - USA and data analyses at the Laboratory of Experimental Neurosciences (LaNEX) of the University of Southern Santa Catarina - Brazil. QEEG Analysis was conducted with the NewMind QEEG Analysis and Client Management system (NewMind, USA) at baseline and after ~3 weeks of intervention.

Results

In comparison to baseline evaluation, the therapeutic approach used herein effectively decreased Metabolic Score (44.94%, data not statically significant - NS) and Total response time (7.97%, NS) (Figure 1A and B, respectively); as well as increased brain plasticity (45.8%), normalization (46.8%), and reorganization (42.8%) (Figure 2). Additionally, cognitive and emotional checklist assessment indicate positive effects on Attention (16.6%, NS), Memory (22.31%, $p<0.05$), Depression (62.05%, $p<0.05$), and Anxiety (31.77%, NS) (Figure 3A to D, respectively).

Conclusion

Audio-Visual Brainwave Entrainment (ABE) associated with Dr. Kelly Miller's "Saving your Brain" therapeutic approach positively affected Quantitative Electroencephalogram (QEEG) Analysis and Cognitive and Emotional Checklist Assessment.

Figures

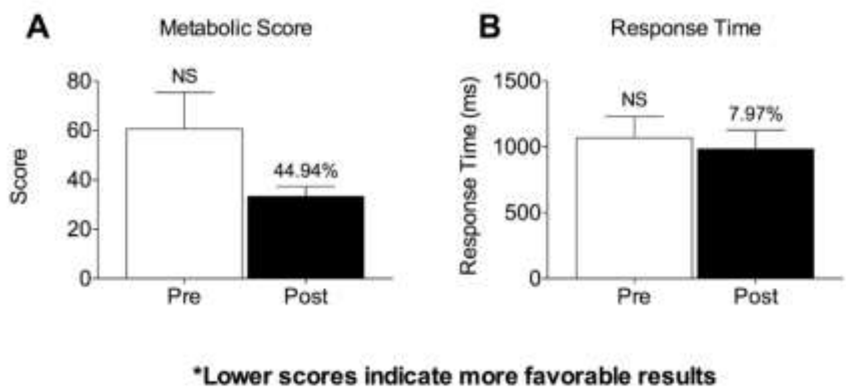

Figure 1 - Effect of Audiovisual Brain Entrainment associated with Dr. Kelly Miller's "Saving your Brain" therapeutic approach on (A) Metabolic score and (B) response time. NS = Not statistically significant (paired T-Test 95% confidence interval - Graphpad Prism software, USA).

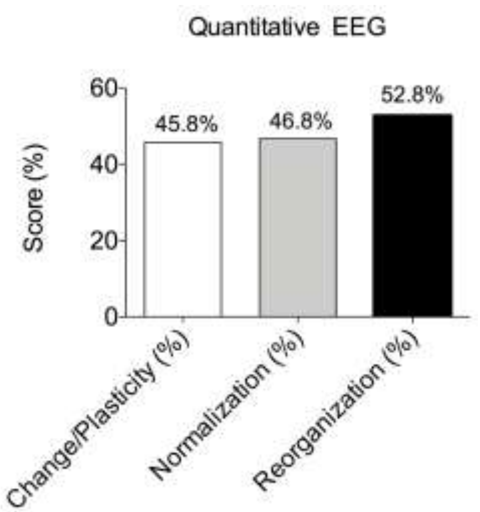

Figure 2 - Effect of Audiovisual Brain Entrainment associated with Dr. Kelly Miller's "Saving your Brain" therapeutic approach on Quantitative Electroencephalogram Analysis (NewMind QEEG Analysis and Client Management system - NewMind, USA)

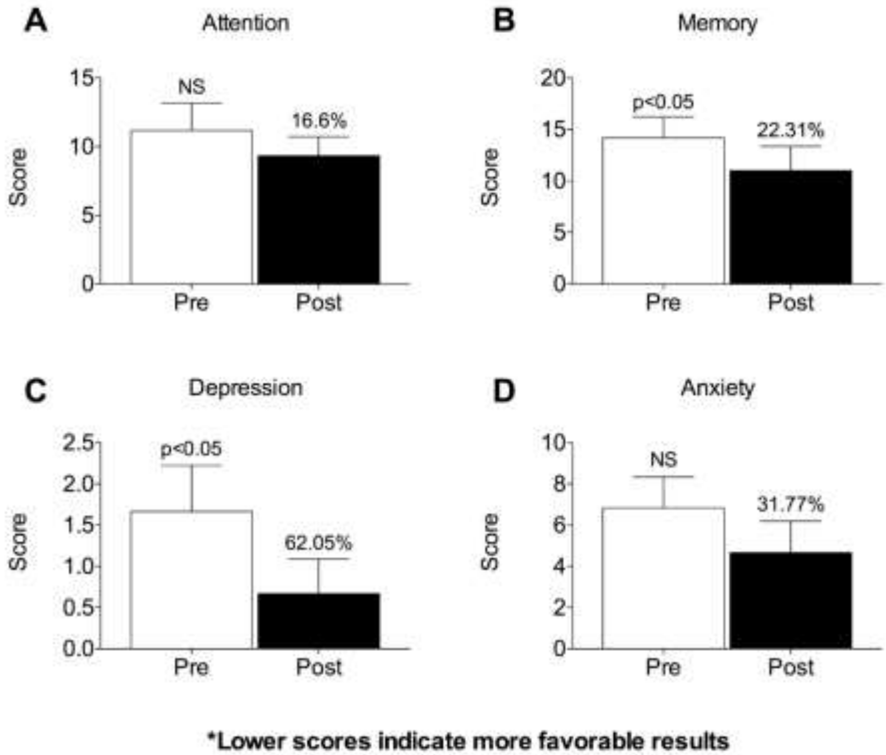

Figure 3 - Effect of Audiovisual Brain Entrainment associated with Dr. Kelly Miller's "Saving your Brain" therapeutic approach on the Cognitive and Emotional Checklist Assessment (A) Attention Score, (B) Memory Score, (C) Depression Score, and (D) Anxiety Score. p<0.05 when comparing to baseline to post-intervention. NS means NS = Not statistically significant (paired T-Test 95% confidence interval - Graphpad Prism software, USA).

Study #5 - Presented at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 (ICIMH-2022).

Effect of Brainwave Entrainment and Transcranial Photobiomodulation on Brainwave Power of College Golf Players

Francisco Jose Cidral-Filho, Ph.D.[1], Eber Fontes, Esp. [2], Patrick Porter, Ph.D.[2], Geraldine Perez, Ph.D.[3]

1. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.
2. Physical therapy Program. University of Ribeirao Preto, SP, Brazil.
3. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
4. Disability Support Services. Seminole State College of Florida. Sanford/Lake Mary Campus. Sanford, FL, USA.

Background
Transcranial photobiomodulation (tPBM) is a novel form of neuromodulation, based on non-retinal exposure to light at specific wavelengths, mainly in the red or near-infrared range. tPBM has been shown to improve memory, attention, and induce sleep regulation. Brainwave entrainment (BWE) refers to the use of rhythmic stimuli with the intention of producing a frequency-following response of brainwaves to match the frequency of the stimuli. The stimulus is usually either visual (flashing lights) or auditory (pulsating tones). BWE has been shown to influence Brainwave power and significantly improve attention; as well as Reduce anxiety and stress. The combination of tPBM and BWE has not yet been studied.

Objective
Investigate the effect of Brainwave Entrainment and Transcranial Photobiomodulation on Brainwave Power of College Golf Players.

Methods
Trial was pre-approved by Seminole State College Internal Review Board. Participants were screened and asked to sign an Informed Consent Form. Sample size consisted of 8 adult female College Golf Athletes (Average of 18 years of age) with no hearing disabilities and no prior use of BWE or tPBM. Participants were randomly assigned by simple draw to either Group A or B. Group A underwent BWE sessions 2 times a week for the first 3 weeks, then tPBM 2 times a week for the next 3 weeks; Group B underwent tPBM for the first 3 weeks, then BWE for the next 3, totaling a 6-week intervention period. BWE was delivered in 20-minute sessions with a BrainTap headset (New Bern, NC). BWE Sessions consisted of Binaural beats and Isochronic Tones varying from 18 to 0.5 HZ as well as visual Entrainment through light-emitting diode lights at 470 nanometers (nm) flickering at the same rate (18 to 0.5 HZ). tPBM was delivered in 10-minute sessions with a tPBM helmet composed of 660 nm (n=100) and 850nm (n=100) evenly distributed. Total irradiance delivered per session was 1000 mW/cm2 per minute. Evaluation of total

brainwave power was conducted with the Emotiv Epoc+ 14-Channel Wireless electroencephalogram (EEG) Headset (San Francisco, CA). EEG sessions were conducted at baseline and after 6 weeks and consisted of 2-minute eyes open immediately followed by 2-minute eyes closed readings. The average of the overall brainwave power of the 14 channels is reported.

Results
Two-tailed Paired T-test with 95% confidence interval (GraphPad software v.9, La Joula, CA) between baseline and end of study EEG evaluations demonstrated the following: decrease in Gamma (-46%, p<0.0098), Low Beta (-24.4%, p<0.1171), High Beta (-46%, p<0.0278), and Theta (-42%, p<0.3206); and an increase in Alpha (90%, p<0.0009).

Conclusion
The interventions used herein induced statistically significant changes in brainwave activity of College Golf Players. To the best of our knowledge this is the first report to demonstrate the combined effects of BWE and tPBM upon brainwave activity.

Figures

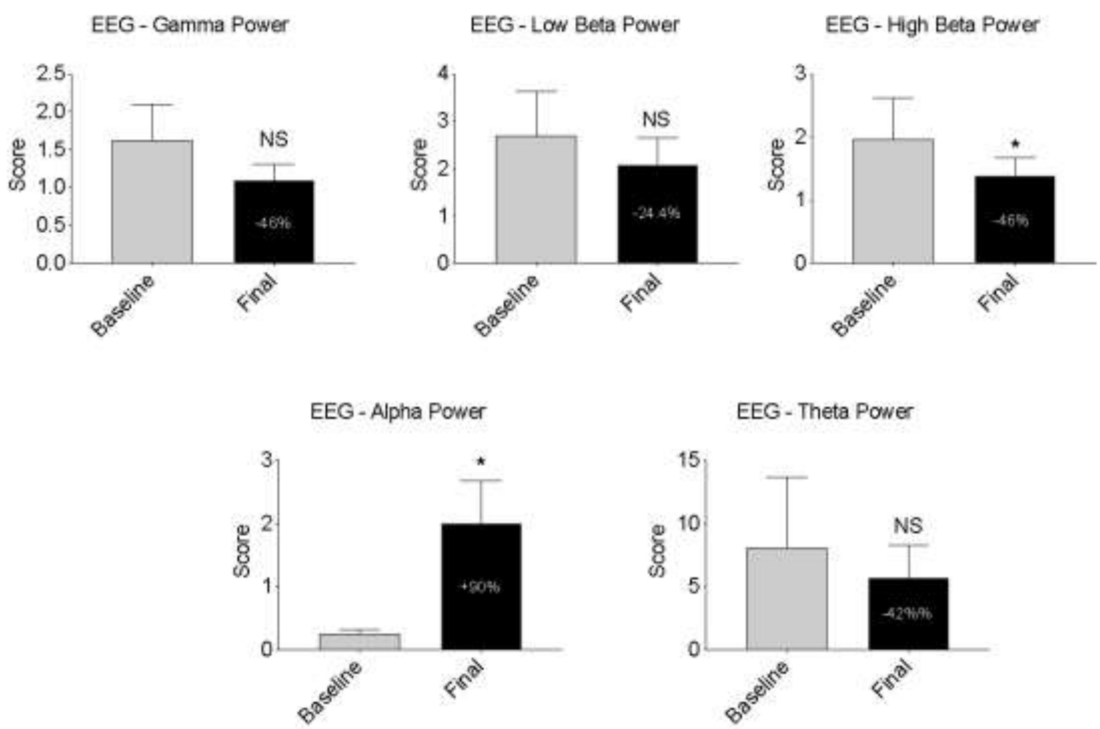

Figure 1 - The effect of Brainwave Entrainment and Transcranial Photobiomodulation on Brainwave Power of College Golf Players. NS = Not statistically significant. *p<0.05 (paired T-Test 95% with a confidence interval - Graphpad Prism software, USA).

Study #6 - Accepted to be presented at the International Congress on Integrative Medicine and Health in Phoenix, AZ, May 2022 (ICIMH-2022).

Use of open-loop audio-visual entrainment to Improve Chronic Insomnia in Adult Dayworkers with Normal Sleep Duration

Michael Keown, Ph.D. Student[1], Francisco Jose Cidral-Filho, Ph.D.[2] , Patrick Porter, Ph.D.[1]

1. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
2. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.

Background
Chronic primary insomnia is one of the most common sleep disorders among adults, including day workers, and is characterized by difficulties initiating (latency) and/or maintaining sleep as well as early morning awakening, which can result in daytime impairment. Aside from conventional pharmacotherapeutic and non-pharmacotherapeutic treatment, no complementary intervention has been found to treat chronic ‘primary’ insomniac adults with normal sleep duration (> 6h). Previous studies have found that open-loop audio-visual entrainment (OLAVE) potentially reduces excessive hyperarousal that is thought to contribute to difficulties with impairment at daytime and initiating and maintaining sleep at nighttime.

Objective
The goal of this study was to assess the efficacy of open-loop audio-visual entrainment to improve chronic insomnia in adult dayworkers with normal sleep duration.

Methods
Fifteen middle-aged day workers were randomly assigned to one of two intervention groups: OLAVE (n = 8, with the Braintap Headset - New Bern, NC) or CONTROL (n = 7) (placebo group) for a period of 6 weeks. Both groups attended six, weekly sessions, during the day, at the same time and day of the week. During the 10-week trial, participants completed four different questionnaires including three self-assessment questionnaires for insomnia symptoms, sleep quality and emotional impairment, and a sleep diary. Actigraph, heart rate and heart rate variability readings were also recorded during the intervention.

Results
After 6 weeks, between-group differences were found in sleep fragmentation (Wake After Sleep Onset - WASO, $p=0.04$) and sleep quality (Pittsburgh Quality of Sleep index - PSQI, $p<0.0001$; Consensus Sleep Diary - CSD, Total Sleep Time Subset, $p=0.004$) in the OLAVE group. Within-group differences showed that both groups reported some improvement in sympathovagal balance and significant improvements in insomnia symptoms (Insomnia Severity Index - ISI, $p<0.05$) and emotional reactivity (impairment)

(p<0.05), which continued to the end of the trial. Improvement in sleep quality (PSQI, p<0.001, CSD, p<0.01), WASO (p<0.01) and sleep efficiency (p<0.05) in the OLAVE group were reported at the 2-week post-intervention period.

Conclusion

Results suggest that OLAVE technology used during daytime may be efficacious in improving chronic insomnia in adult dayworkers with normal sleep length.

Figures

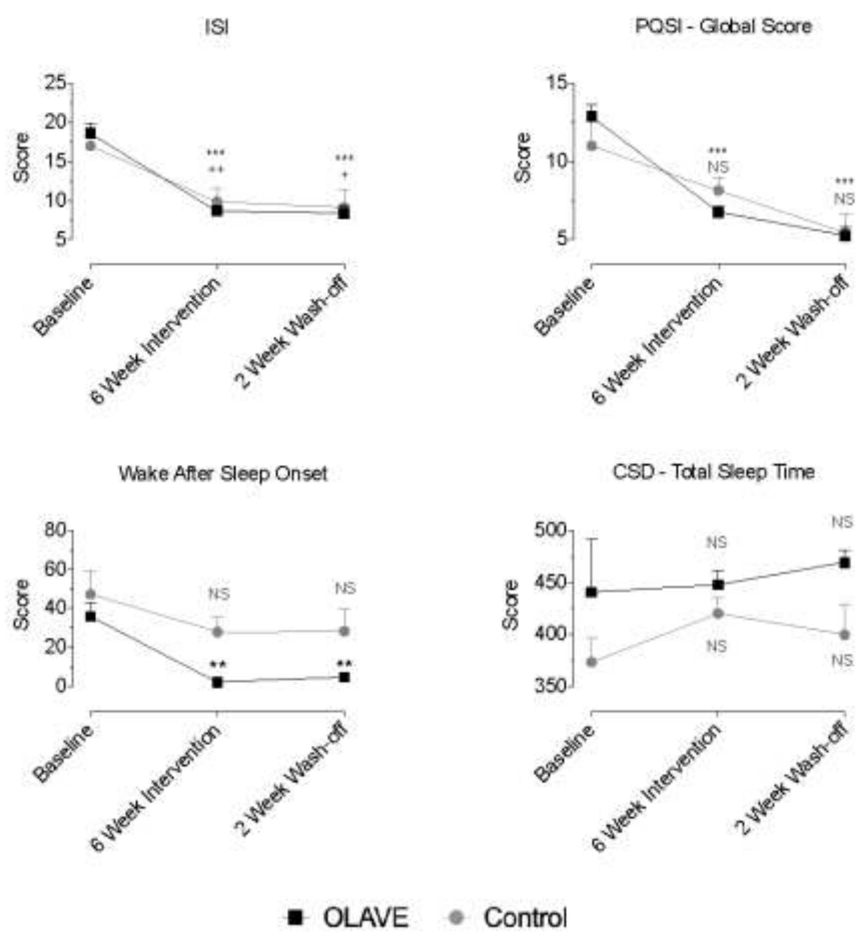

Figure 1 - The use of open-loop audio-visual entrainment to Improve Chronic Insomnia in Adult Dayworkers with Normal Sleep Duration. Effects upon Insomnia Severity Index (ISI), WASO (Wake After Sleep Onset), Pittsburgh Quality of Sleep index (PSQI), Consensus Sleep Diary (CSD, Total Sleep Time Subset). When comparing within-group differences with Baseline: NS = Not statistically significant, **p<0.01, ***p<0.001 for OLAVE group; $^{+}$p<0.05, $^{++}$p<0.01 for Control Group (Two-way ANOVA repeated measures followed by Bonferroni post-hoc Test - Graphpad Prism software, USA).

Study #7 - PhD Thesis in the 2021 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.

Effect of audiovisual Brainwave Entrainment on Weight Reduction, Stress and Heart Rate variability

Jody Dowd [1], Cidral-Filho, F.J.[2]; Porter, P.[1]

1. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
2. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.

Objective
To evaluate the effect of audiovisual brainwave Entrainment (BWE) with the BrainTap headset on weight loss, stress, and heart rate variability.

Methods
Sample size consisted of 12 participants (three men and nine women, ages of 29 and 63, BMI of at least 30, who wanted to lose at least 15 pounds. Baseline assessments consisted of body weight (Health O Meter, USA), stress and heart rate variability (through the Neuralchek device, New Bern, USA). Participants were then asked to listen to two BWE sessions from the Braintap Application of their choice each day (one in the morning - in the Motivation category) and one in the evening (in the Relaxation category) with two of them being Weight Loss category sessions each week.

Results
12 participants were initially enrolled, but only 8 completed the program and the evaluations. A weight reduction of 2.125 pounds was recorded at the end of the program ($p=0.0243$ - Figure 1), and stress index was also reduced (24.1%, although stress index data was not statistically significant $p=0.2013$ - Figure 2). Additionally, although not statistically significance was obtained, assessments also indicated increased HRV, increased parasympathetic activity and increased balance between sympathetic and parasympathetic (Figure 2), as decrease in the LF/HF ratio indicates vagal activation, with results closer to 1 (one) reflecting better sympathovagal balance.

Conclusion
Audiovisual Brainwave Entrainment positively affected Weight Reduction. Results also indicate a positive effect on stress and Heart rate variability (with increased HRV, increased parasympathetic activity and increased sympathovagal balance), although data was not statistically significant, we argue that a larger size study is awarded.

Figures

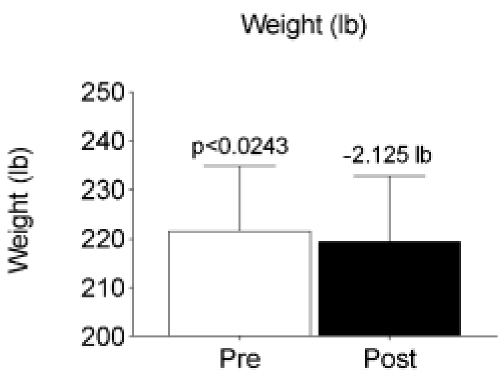

Figure 1 - Effect of audiovisual Brainwave Entrainment on Weight Reduction. Paired T-Test with a 95% confidence interval - Graphpad Prism software, USA.

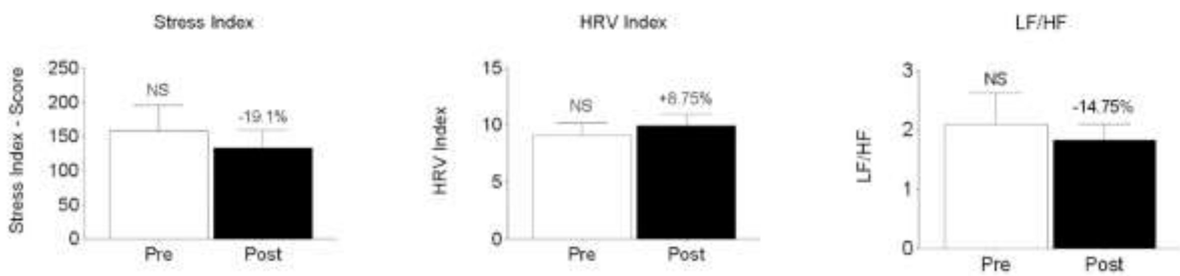

Figure 2 - Effect of audiovisual Brainwave Entrainment on Stress, Heart Rate Variability (HRV) and Low Frequency (LF) to High Frequency (HF) ratio. NS = Not statistically significant (Paired T-Test with a 95% confidence interval - Graphpad Prism software, USA).

Study #8 - PhD Thesis in the 2022 postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.

Effects of the Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program, either alone or in combination with Braintap Brainwave Entrainment (BWE), on Weight Loss; Quality of Sleep, Mood, Anxiety, and Stress.

Kim White[1], Cidral-Filho, F.J.[2]; Porter, P.[1]

1. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
2. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, SC, Brazil.

Objective
To evaluate the effects of the Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program, either alone or in combination with Braintap Brainwave Entrainment (BWE), on Weight Loss; Quality of Sleep, Mood, Anxiety & Stress.

Background
The Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program includes guidance for eating, moving, and thinking differently to reduce body weight and lead a healthier lifestyle. This guidance is based upon over 20 years of practice, research, and implementation of a healthy system.

Methods
Participants were screened and asked to sign this Consent Form. Participants then took the baseline evaluations: weight measurements as well as questionnaires (Pittsburgh Quality of Sleep Index - PQSI, Perceived Stress Scale - PSS, Generalized Anxiety Disorder 7 - GAD7, Profile of Mood States - POMS), and were randomly assigned to the intervention groups (GROUP HH or HH+BWE) with a computer-based random number generator (www.randomizer.org). Group HH participants underwent the Ready4Rapid program for 13 weeks, Group HH+BWE did so I combination with daily BWE sessions with the Braintap APP. All participants were re-evaluated after 3 and 6 weeks, i.e., midway and at the end of the intervention. Participants participated in the Ready 4 Rapid Results program by watching weekly videos, completing exercises and paperwork. They had weekly 1-hour meetings and a 15-minute Coaching Call or Zoom. BWE Group underwent daily 20-minute Brainwave Entrainment sessions.

Results
17 participants were initially enrolled, but only 9 completed the program and all 3 evaluations, 4 in HH group and 5 in HH+BWE group. Both groups presented weight reduction (from 3.4 To 5.6 pounds at the end of the experiment) with no statistically significant differences between groups (Figure 1). Although Quality of Sleep was not affected, both groups presented positively better scores in the POMS, PSS and GAD-7 questionnaires in comparison to baseline, although statistically significant results were

only present in the POMS and the GAD-7 questionnaire and only for the HH+BWE group (Figure 2). Lastly, both interventions positively influenced Mood, with statistically significant results in comparison to baseline in the Tension and POMS negatives subscales, as well as on the overall score in the BWE group (Figure 3).

Conclusion

The Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program did not influence quality of sleep, but positively affected Weight Loss, Mood, Anxiety, Stress. As statistically significant results in comparison to the baseline evaluations were only obtained in the HH+BWE group, data suggests that Braintap Brainwave Entrainment potentiated the effects of the interventions. Taken together, these data suggest that Braintap Brainwave Entrainment is an effective adjuvant therapy for weight loss and mood management programs.

Figures

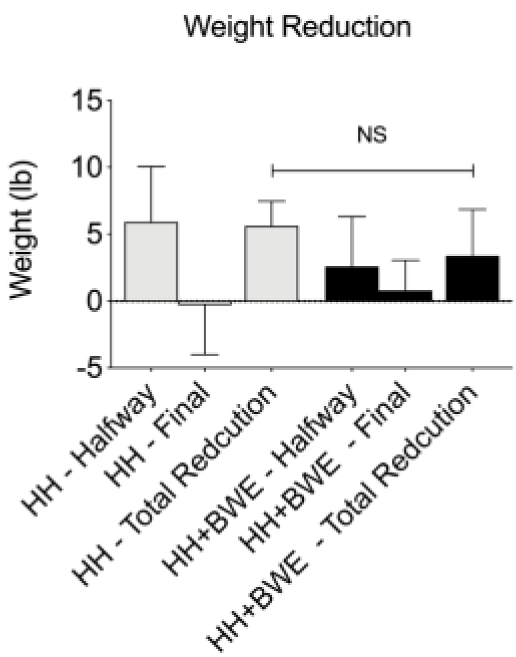

Figure 1 - Effects of the Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program, either alone (HH) or in combination with Braintap Brainwave Entrainment (HH+BWE), on Weight Reduction. NS = Not statistically significant (Unpaired T-Test with a 95% confidence interval - Graphpad Prism software, USA).

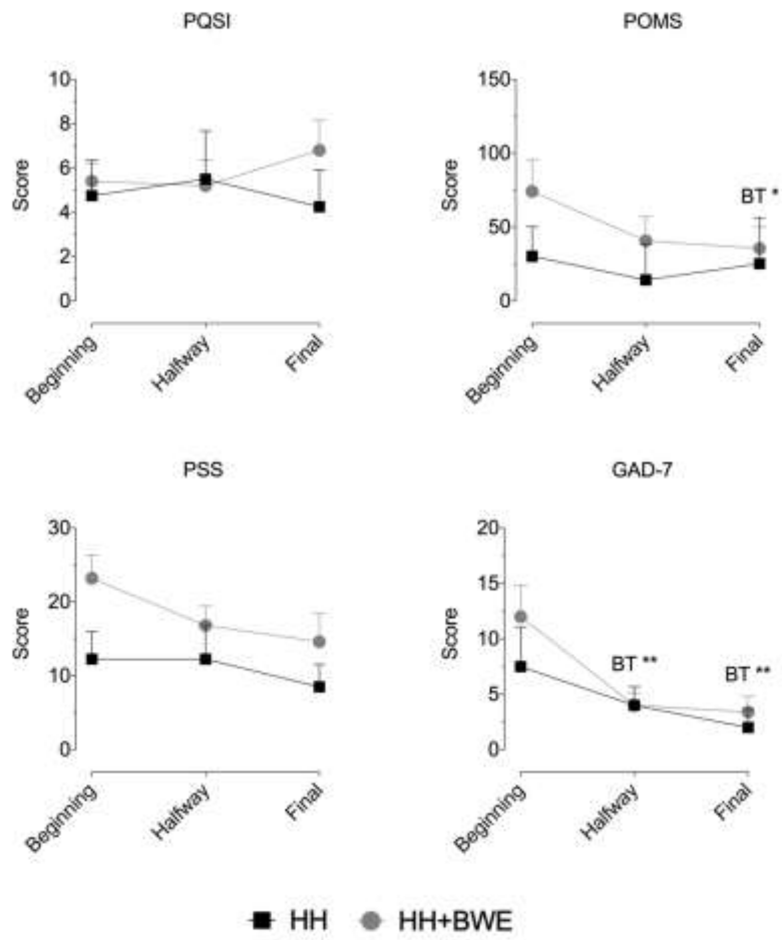

Figure 2 - Effects of the Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program, either alone (HH) or in combination with Braintap Brainwave Entrainment (HH+BWE), on Quality of Sleep (PQSI), Mood (POMS), Anxiety (GAS-7) & Stress (PSS). NS = Not statistically significant, **p<0.01 (Two-way ANOVA repeated measures followed by Bonferroni Post-hoc Test - Graphpad Prism software, USA).

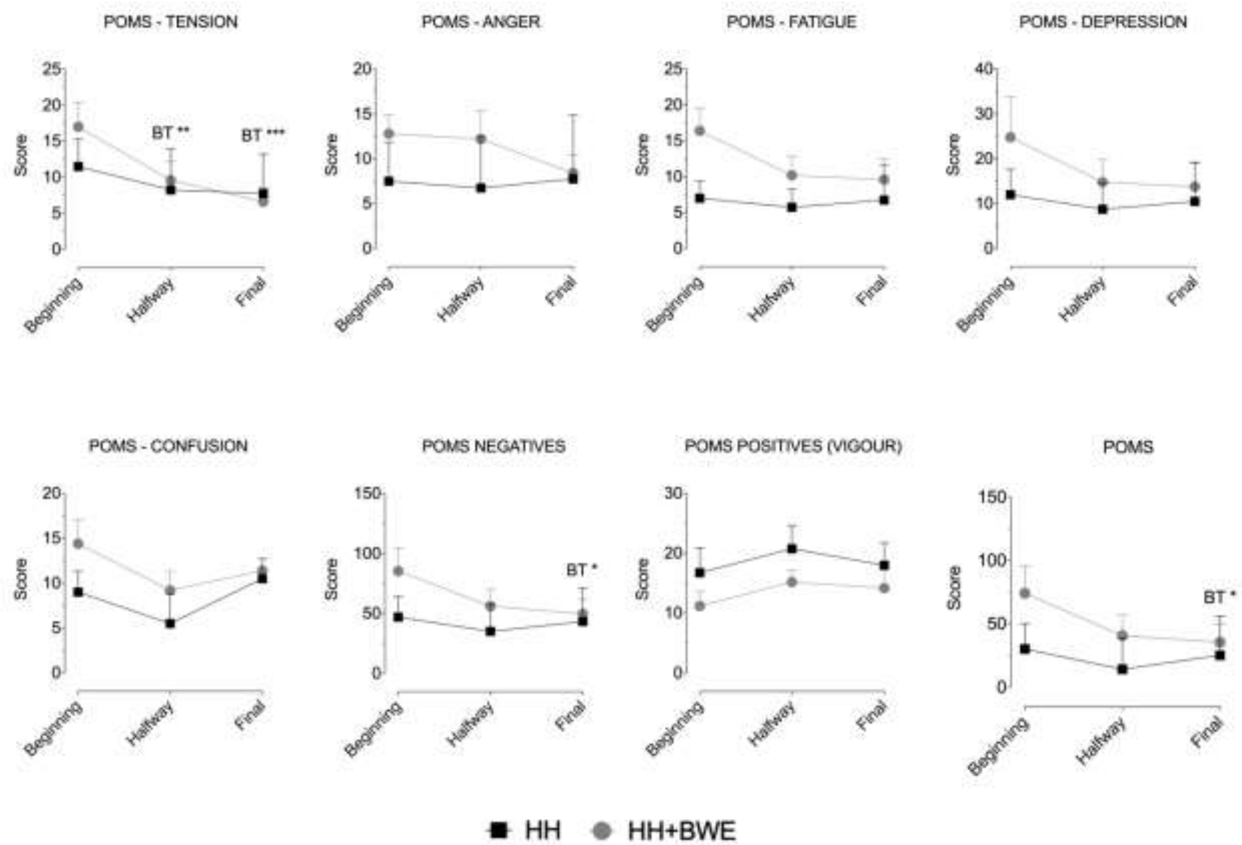

Figure 3 - Effects of the Ready 4 Rapid Results H.E.A.L.T.H.Y. H.A.B.I.T.S. 13-week program, either alone (HH) or in combination with Braintap Brainwave Entrainment (HH+BWE), on Mood (POMS subscales). NS = Not statistically significant, *p<0.05, **p<0.01, ***p<0.001 (Two-way ANOVA repeated measures followed by Bonferroni Post-hoc Test - Graphpad Prism software, USA).

Study #9 - Study conducted with Julia Arndt (the Peak Performance Method creator). Conducted Online in 2020.

The Effect of the Peak Performance Method (PPM) combined with Audio Brain Entrainment on Anxiety, Sleep, Stress and Work Productivity of Professionals

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2. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina, Brazil.

Background

Developed by Julia Arndt, the Peak Performance Method (PPM) combines critical productivity, mindfulness and leadership tools with neuroscientific research on emotion regulation, habit-building and change management as well as coaching techniques to help people develop the next workplace superpower to thrive in today's high-pressure environments. Audio Brain Entertainment (ABWE) guides the mind from an awake, reactionary mind into an intuitive, creative state, then to a place where super-learning and healing can occur, with the outcome being a heightened state of consciousness with crystal clear focus. ABWE creates a symphony of brainwave activity, a feeling of calm focus for learning and productivity. Each session is designed with brainwave balance in mind. Unlike meditation programs, BrainTap's exclusive neuro-algorithms gently and naturally guide your brain through a broad range of brainwave patterns, instead of just the Alpha state. The result is a complete spectrum of brainwave activity.

Objective

The objective of this study was to investigate the effect of the Peak Performance Method (PPM) combined with Audio Brain Entrainment (ABWE) on Anxiety, General Health, Stress, Quality of Sleep, mindset and Work productivity of professionals.

Methods

Sample size consisted of 20 professionals of varying backgrounds (14 females and 6 males aged between 28 and 55). Professionals work in tech, consulting and telecommunication. 14 individuals are currently employed full-time, 5 individuals are self-employed and 1 not employed at the time. Group 1 and 2 learned the basics of PPM in 9 weekly pre-recorded 30-45-minute sessions, each session including a workbook with 3-5 journaling prompts for self-reflection and additional action items. Additionally, the participants were asked to complete a 5-minute reflection exercise at the end of each day to increase self-awareness and promote well-being. Furthermore, Group 2 deepened their learnings by adding 20-minute PPM-Braintap sessions 3 times a week for 9 weeks to influence their subconscious mind to make long-lasting changes in the following three areas: mindfulness, productivity and leadership.
The following questionnaires were applied at baseline and after 9 weeks to analyze the participants change in stress, sleep, mindset and productivity:

- Perceived Stress Scale (PSS);
- Pittsburgh Quality of Sleep Index (PQSI);
- Depression Scale (PQ-8);
- Mindset Scale by Carol Dweck;
- PPM Scale by Julia Arndt (not validated).

Results

PPM whether or not combined with ABWE positively affected all scores.
Results indicate positive effects of PPM on all scales evaluated. When PPM was combined with ABWE effects were more pronounced in most scales.

- PSS (33% reduction for PPM and 45% when combined with ABWE). In this scale a score of 0-13 indicates low stress levels; 14-26 - moderate stress and 27-40 - high perceived stress.
- PHQ-8 (18% reduction for PPM and 71% when combined with ABWE). Patient Health Questionnaire depression scale (PHQ-8) is established as a valid diagnostic and severity measure for depressive disorders. A score of 10 or greater is considered major depression, 20 or more is severe major depression. Statistically significant results were obtained in post-hoc analysis when comparing PPM+ABWE group with its baseline ($p<0.05$).
- PQSI (48% reduction for PPM and 51% when combined with ABWE). PQSI global score ranges from 0 to 21. Higher scores indicate worse sleep quality. Global sum of “5” or greater indicates a “poor” sleeper.
- Work Dimension (26% increase for PPM and 28% when combined with BrainTapping). The higher the score the better the outcome. Statistically significant results were obtained in post-hoc analysis when comparing PPM+ABWE group with its baseline ($p<0.05$).
- Mindset (41% increase for PPM and 19% when combined with ABWE). The higher the score the better the outcome.
- Beliefs and Values (10% increase for PPM and 3% when combined with ABWE). The higher the score the better the outcome.

Conclusion

Despite the reduced sample size (N=12 participants completed the study end-to-end) PPM positively affected scores related to anxiety, general health, stress, quality of sleep, as well as work productivity. Additionally, combining ABWE with PPM leads to more significant effects on most of the outcomes assessed in this study. Statistically significant results were obtained in post-hoc analysis when comparing PPM+ABWE group with its baseline ($p<0.05$) in two scales: PHQ-8 and Work Dimension assessments.

Figures

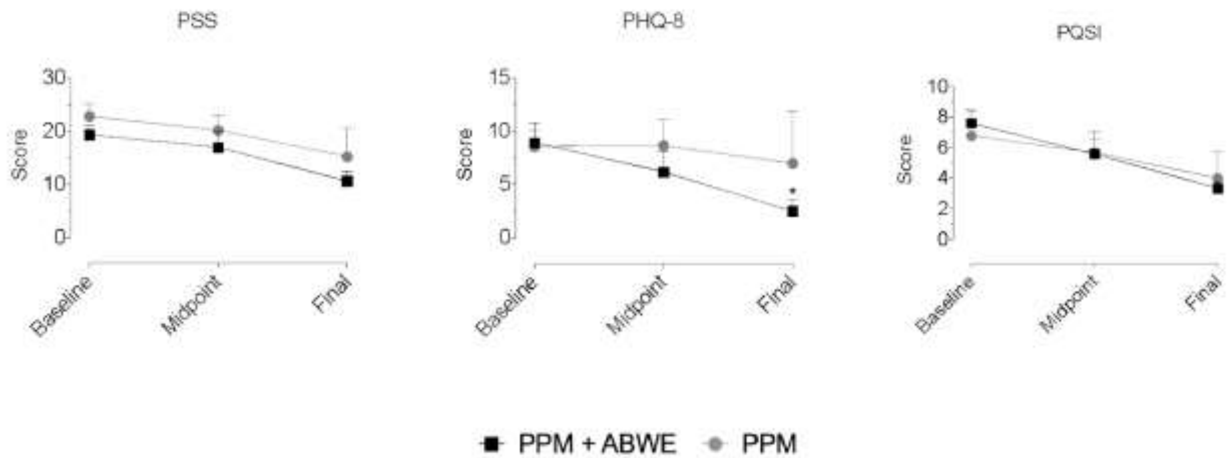

Figure 1: Effect of Peak Performance Method (PPM) and combination with Audio Brainwave Entrainment on Perceived Stress Scale (PSS), Patient Health Questionnaire (PHQ-8) and Pittsburgh Quality of Sleep Index (PQSI). *p<0.05 when comparing PPM+ABWE group with Baseline (Two-way ANOVA repeated Measures followed by Bonferroni Post-hoc analysis - prism Graphpad 9, La Jola, CA, USA).

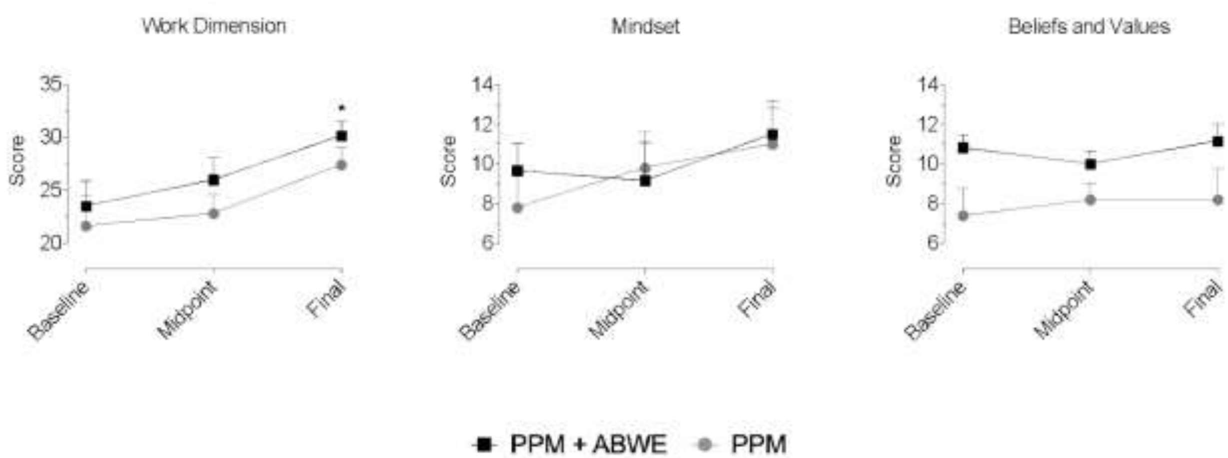

Figure 2: Effect of Peak Performance Method (PPM) and combination with ABWE on Work Dimension, Mindset and Beliefs and Values Assessment. *p<0.05 when comparing PPM+ABWE group with Baseline (Two-way ANOVA repeated Measures followed by Bonferroni Post-hoc analysis - prism Graphpad 9, La Jola, CA, USA).

Study #11 - Study conducted by Dr. Arkfeld at the Gaylord High School in Gaylord, MI, United States. 2020-2021.

Study #10 - Study conducted by Dr. Arkfeld at the Gaylord High School in Gaylord, MI, United States. 2020-2021.

Concussion Treatment Protocol Utilizing Brainwave Entrainment with the BrainTap headset & Compression Therapy with the NormaTec Pulse 2.0.

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1. Postgraduate Program in Integrative Medicine. Quantum University. Honolulu, HI, USA.
2. Laboratory of Experimental Neuroscience (LaNEX) - Health Sciences Post-Graduation Program - University of Southern Santa Catarina (UNISUL), Brazil.

Objective
Evaluate the effect of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with the NormaTec Pulse 2.0 Legs device as adjuvant to the treatment of sports-related concussion in high school athletes from boys and girls soccer, boys and girls basketball, girls softball, football, and cheerleaders.

Methods
Control group patients (n=6) who sustained a sports-related concussion and were under care for concussion-related symptoms were treated with low force chiropractic manipulations, electrical muscle stimulation, and neuromuscular reeducation exercises using the oscillating technique for isometric stabilization tools. During the first 10 days of intervention patients were seen daily, then the frequency was reduced to 3 times per week until release from active care (which varied based on the individual patient's response to care). BWE+CT group (n=10) received same interventions as the Control group along with BWE with the BrainTap Headset in combination with CT with the NormaTec Pulse 2.0 Legs device. In the first 10 days of intervention BWE sessions consisted of Sensorimotor Rhythm (SMR) recordings, either 10 or 20 minutes in duration. From the 10th day onwards the "Stress Relief" series in the Braintap App were used. All BWE sessions were conducted in conjunction with CT with the NormaTec Pulse 2.0 Legs device. One year after the interventions ceased and the patients had been released from care, they were asked to complete a Post-Concussion Assessment on the lingering effects they were still experiencing.

Results
BWE+CT group reported less severe symptoms in all items, with a reduction from 30 to 90% in relation to Control group. Statistically significant differences between the groups were found in the following items: neck pain ($p<0.05$), dizziness ($p<0.05$), balance problems ($p<0.01$), sensitivity to noise ($p<0.05$), fatigue or low energy ($p<0.01$), feeling more emotional ($p<0.05$), and irritability ($p<0.05$) (Figures 1-4).

Conclusion
The combination of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with NormaTec Pulse 2.0 Legs device effectively reduced the

long-lasting or lingering symptoms of sports-related concussion in high school athletes from boys and girls soccer, boys and girls basketball, girls softball, football, and cheerleaders in comparison to Control group interventions. Better results were seen more than a year after the interventions.

Figures

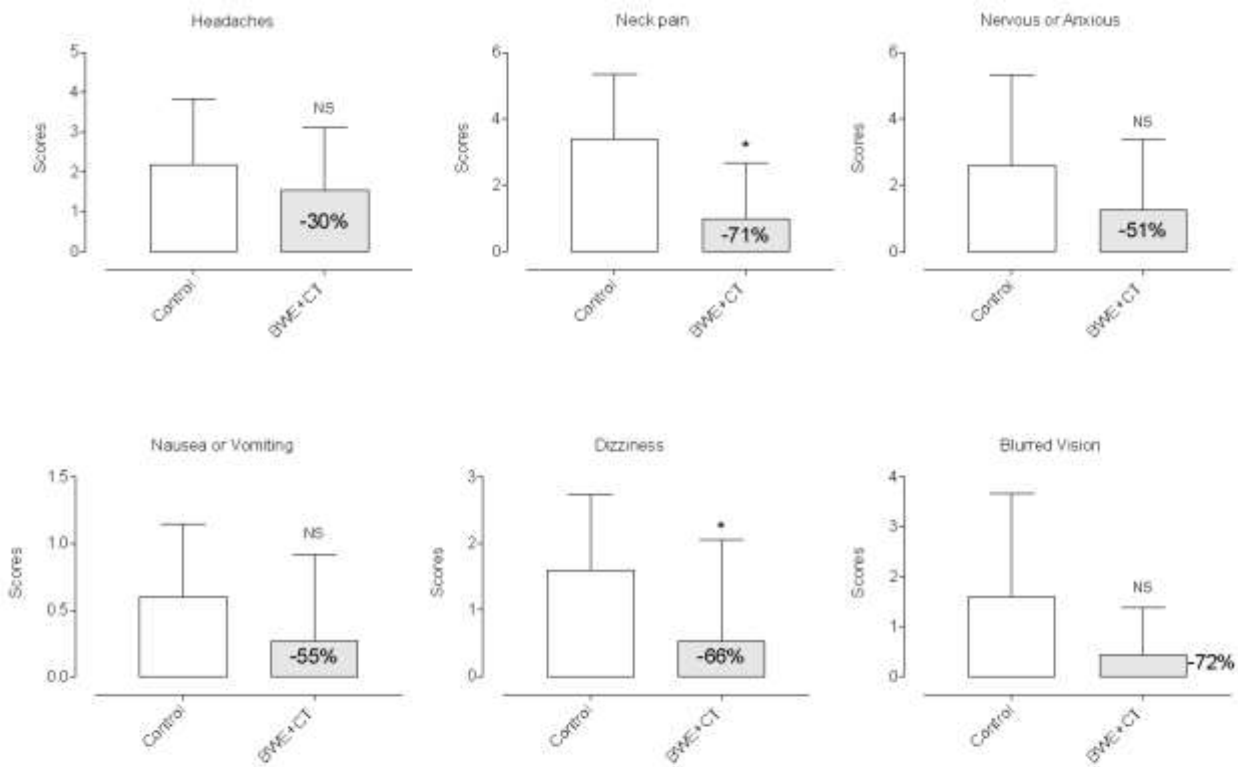

Figure 1 - The combination of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with NormaTec Pulse 2.0 Legs device effectively reduced the long-lasting or lingering symptoms of sports-related concussion in comparison to Control group interventions. NS = Not statistically significant. *p<0.05, **p<0.01 (paired T-Test 95% with a confidence interval - Graphpad Prism software, USA).

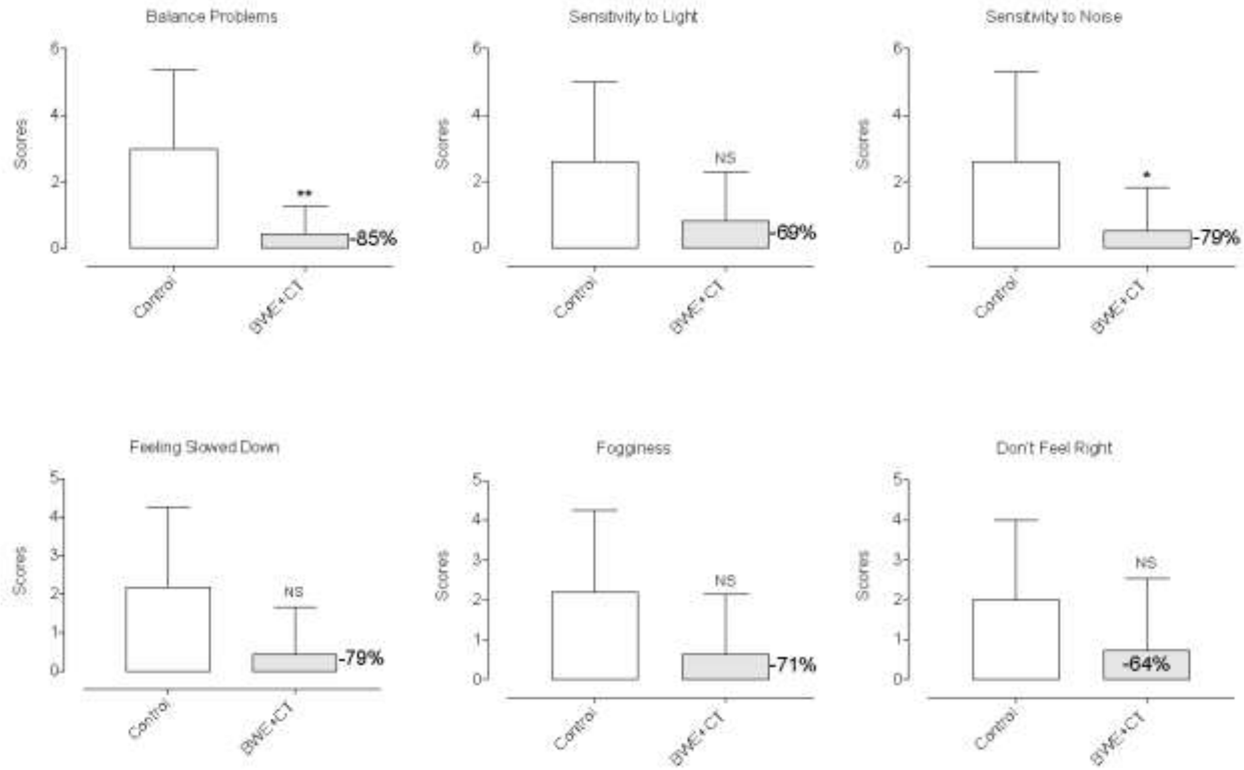

Figure 2 - The combination of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with NormaTec Pulse 2.0 Legs device effectively reduced the long-lasting or lingering symptoms of sports-related concussion in comparison to Control group interventions. NS = Not statistically significant. *p<0.05, **p<0.01 (paired T-Test with a 95% confidence interval - Graphpad Prism software, USA).

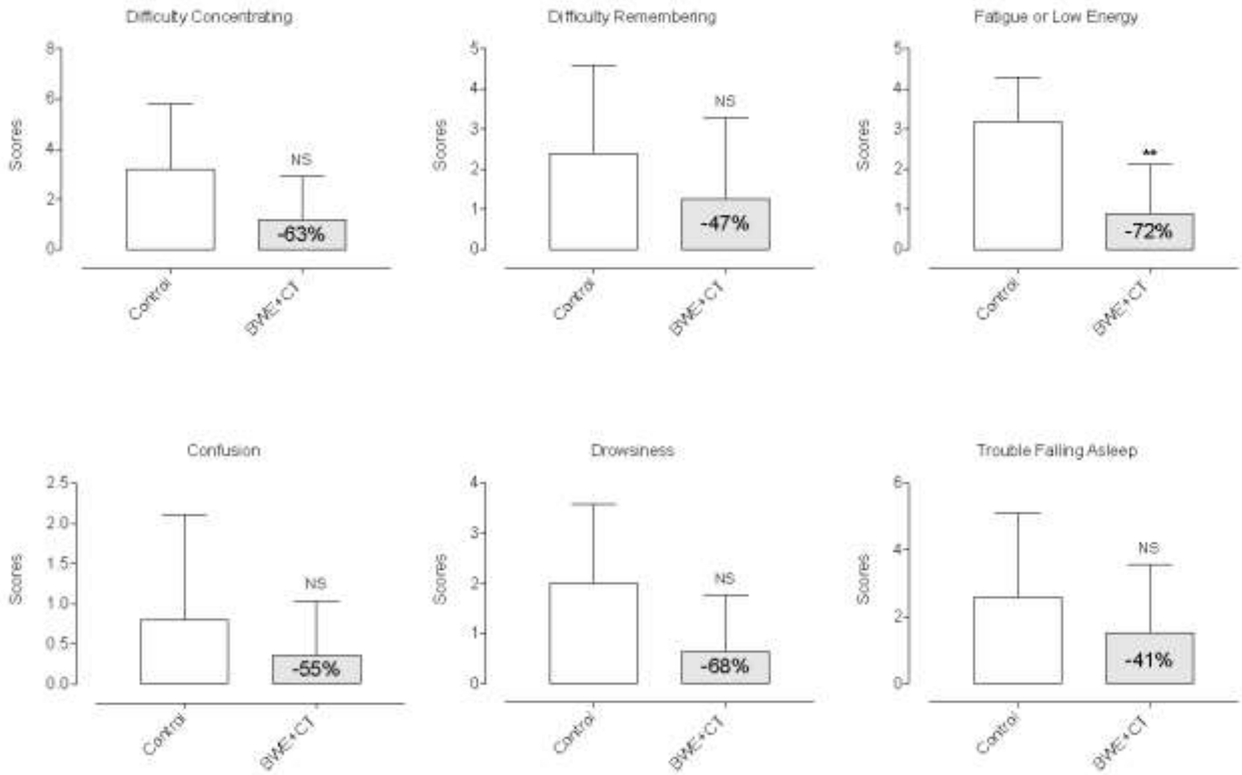

Figure 3 - The combination of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with NormaTec Pulse 2.0 device effectively reduced the long-lasting or lingering symptoms of sports-related concussion in comparison to Control group interventions. NS = Not statistically significant. *p<0.05, **p<0.01 (paired T-Test with a 95% confidence interval - Graphpad Prism software, USA).

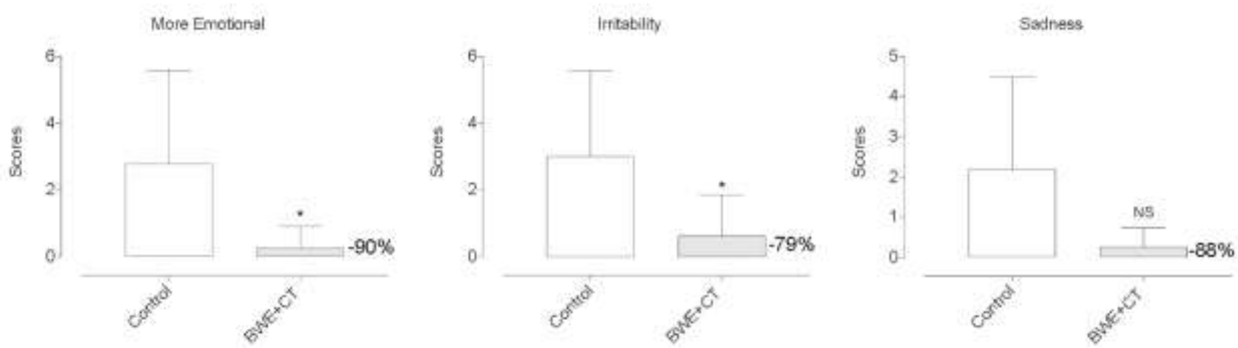

Figure 4 - The combination of Brainwave Entrainment (BWE) with the BrainTap headset and compression therapy (CT) with NormaTec Pulse 2.0 device effectively reduced the long-lasting or lingering symptoms of sports-related concussion in comparison to Control group interventions. NS = Not statistically significant. *p<0.05, **p<0.01 (paired T-Test with a 95% confidence interval - Graphpad Prism software, USA).

Study #11 - Internal study conducted with BioStrap & BrainTap team members. Conducted Online in 2021.

Effect of Audio-Visual Brain Entrainment on Stress, Mood and Quality of Sleep: a trial with BioStrap & BrainTap team members.

Kevin Longoria[1]; Erin Miller[2]; Francisco Cidral[2,3]

1. BioStrap LLC, Los Angeles CA
2. Braintap Technologies, New Bern NC - USA.
3. Laboratory of Experimental Neurosciences (LaNEX), University of Southern Santa Catarina (UNISUL), Brazil.

Objective

The study Objective was to investigate the effects of the Audio-Visual Brain Entrainment (ABE) on Stress, Mood and Quality of Sleep of BioStrap & BrainTap team members.

Methods

Sample size consisted of 32 volunteers who were not making use of analgesics, anti-inflammatories or sleep aids at least seven (7) days prior to, as well as during the study, and who had no hearing disabilities. Study was conducted over the course of 5 weeks. During weeks 1 and 2 (From May 5th to 18th): Baseline Evaluation Phase. Participants were asked NOT to undergo BWE sessions. During weeks 3, 4 and 5 (From May 19th to June 9th): Intervention phase. Participants were asked to undergo two (2) Braintap sessions a day. Assessments consisted of (1) online questionnaires and (2) "Sleep Tracking with the Biostrap device". Online questionnaire consisted of five (5) parts: Part 1: Questions on the use of Braintap and overall health and wellness questions; Part 2: Pittsburgh Quality of Sleep Index: to access Quality of Sleep - as a counterpoint to BioStrap. Part 3: Perceived Stress Scale: to measure the perception of stress. Part 4: The Brief Resilience Scale: to assess the ability to bounce back or recover from stress. Part 5: Profile of Mood States: a widespread instrument which measures mood. The questionnaires were conducted on the following dates: On May 5th: Baseline Questionnaires; On May 19th: Beginning of Intervention Questionnaires; On June 9th: End of Study Questionnaires. (2) Sleep Tracking with the Biostrap device: The participants were asked to wear the BioStrap Band during the two phases of the study (Baseline and Intervention). ABE sessions were delivered with the BrainTap App and/or a BrainTap headset (New Bern - NC - USA) in 20 to 30-minute sessions twice (2x) a day during the intervention phase (from May 19th to June 9th). The sessions entailed background music, guided meditation, as well as audio or audiovisual brainwave entrainment through binaural beats, isochronic tones and, in the case of the use of the headset, photic stimulation. Results indicate that Audio-Visual Brain Entrainment (ABE):

- Significantly decreased Stress and increased Quality of Sleep, Perceived stress and Mood (as assessed through validated research questionnaires - Figures 1, 2 and 3) but did not affect Resilience (Brief Resilience Scale - Figure 2B);
- Significantly increased quality of sleep, mood, energy levels; decreased the feeling of being nervous and stressed, annoyed or irritable; and increased the feeling of being “on top of things” and productive (as assessed through self-reported 10-point Likert scale - Figure 4);
- In regards to the data assessed with the BioStrap Bands, although results were trending to on a positive direction, data were not statistically significant [resting heart rate, resting Heart rate variability (HRV), peripheral capillary oxygen saturation (SpO2), respiratory rate, arterial elasticity, peripheral elasticity, arterial age, sleep duration, seep efficiency (%), deep sleep (in minutes), light sleep (in minutes), total time Awake (in minutes), sleep awakenings (number of events), sleep Score (0-100 scale), recovery Score (0-100 scale) - Figures 5 through 8].

In relation to adherence to BrainTap during the intervention phase of study, “end of the study questionnaire” yielded the results (Figure 9):

- 52.4% of the participants consistently used BrainTap twice (2x) a day during intervention phase; 47.6% did not.
- 9.5% of the participants reported undergoing zero (0) BrainTap sessions a day; 33.3%, one session; and 57.1%, two sessions a day. No participants underwent three sessions a day.
- 19% of the participants generally used only the App; 81% generally the APP + Headset; and 4.8% of the participants did not generally BrainTap.

Conclusion

Overall results indicate that ABE significantly decreased Stress, increased Quality of Sleep, Mood and energy levels. Actigraphy data collected with the BioStrap Bands, although not statistically significant, indicated improvement in all parameters analyzed.

Figures

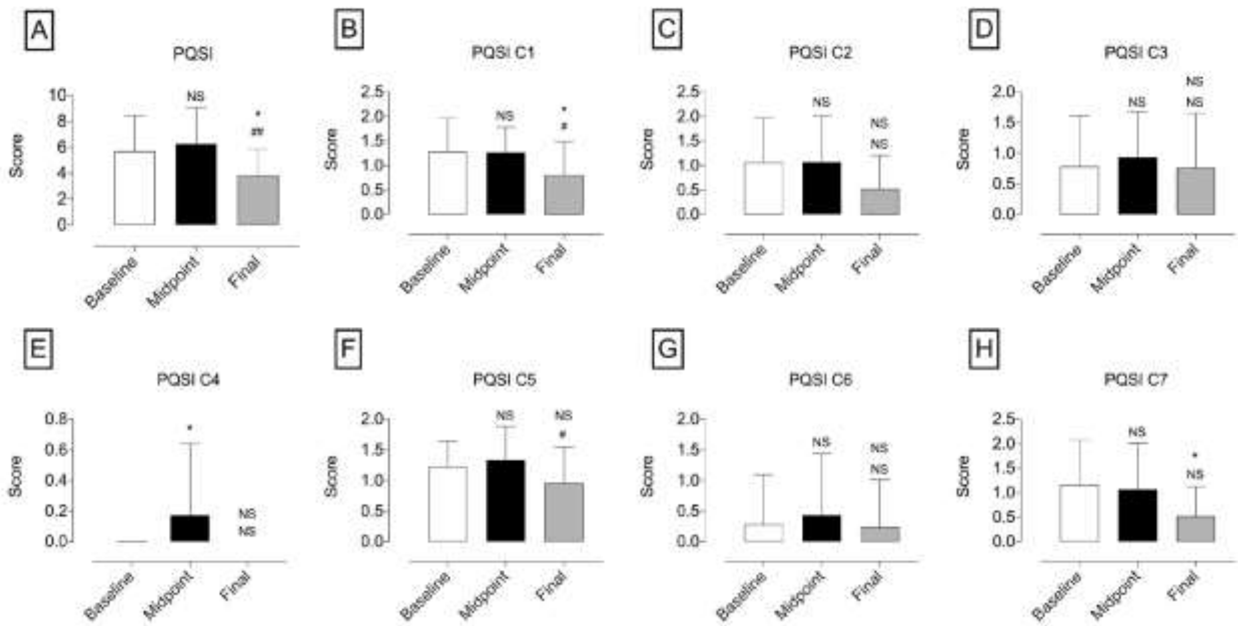

Figure 1 - Pittsburgh Quality of Sleep Index (PQSI). Global PSQI Score (Panel A); Component 1 (C1 - Panel B): Subjective sleep quality; Component 2 (C2 - Panel C): Sleep latency; Component 3 (C3 - Panel D): Sleep duration; Component 4 (C4 - Panel E): Sleep efficiency; Component 5 (C5 - Panel F): Sleep disturbance; Component 6 (C6 - Panel G): Use of sleep medication; Component 7 (C7 - Panel H): Daytime dysfunction. NS: Not statistically significant. *$p<0.05$ when compared to baseline evaluation, #$p<0.05$ when compared to midpoint Evaluation. Ordinary One-Way Anova followed by Tukey's multiple comparisons test or Kruskal-Wallis test followed by Dunn's multiple comparisons test, where applicable (prism graphpad 8, La Jola USA).

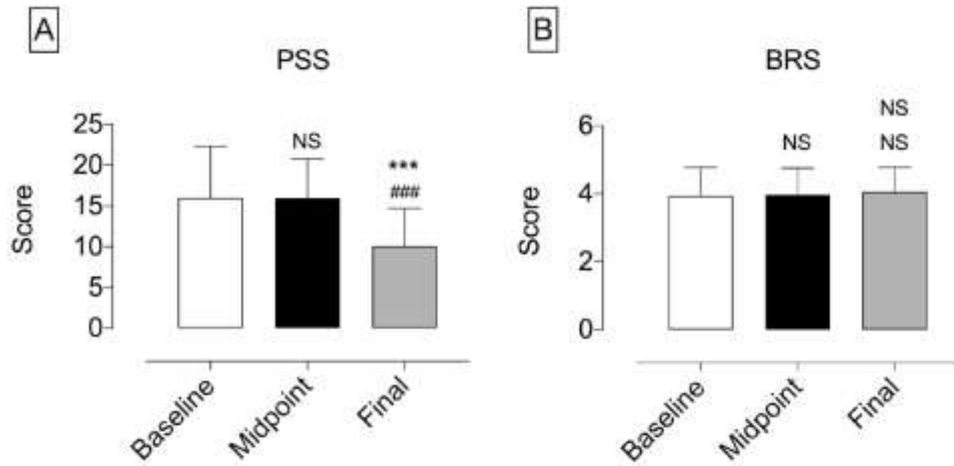

Figure 2 - Perceived Stress Scale (Panel A); The Brief Resilience Scale (Panel B). NS: Not statistically significant. ****p<0.001* when compared to baseline evaluation, ###*p<0.001* when compared to midpoint Evaluation Ordinary One-Way Anova followed by Tukey's multiple comparisons test (prism graphpad 8, La Jola USA).

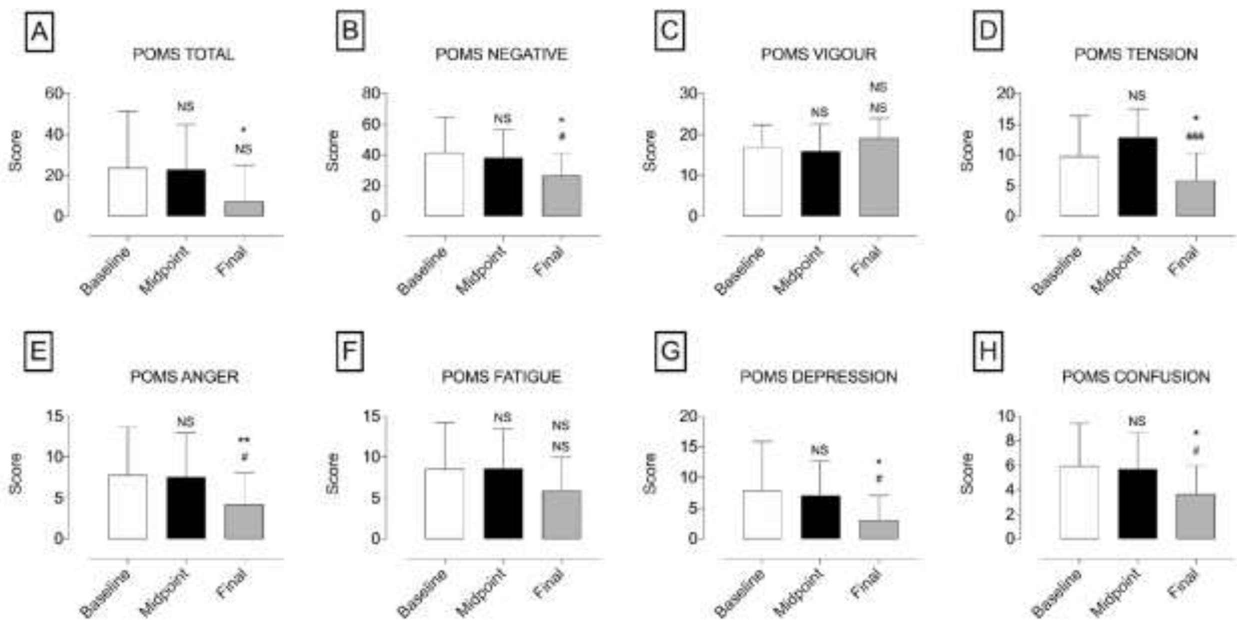

Figure 3 - Profile of Mood States (POMS). Total score (Panel A); POMS Negative Aspects (Panel B); Vigor score (Panel C); Tension score (Panel D); Anger score (Panel E); Fatigue score (Panel F); Depression score (Panel G); Confusion score (Panel H). NS: Not statistically significant. **p<0.05, **p<0.01* when compared to baseline evaluation, *#p<0.05, ###p<0.001* when compared to midpoint Evaluation. Ordinary One-Way Anova followed by Tukey's multiple comparisons test or Kruskal-Wallis test followed by Dunn's multiple comparisons test, where applicable (prism graphpad 8, La Jola USA).

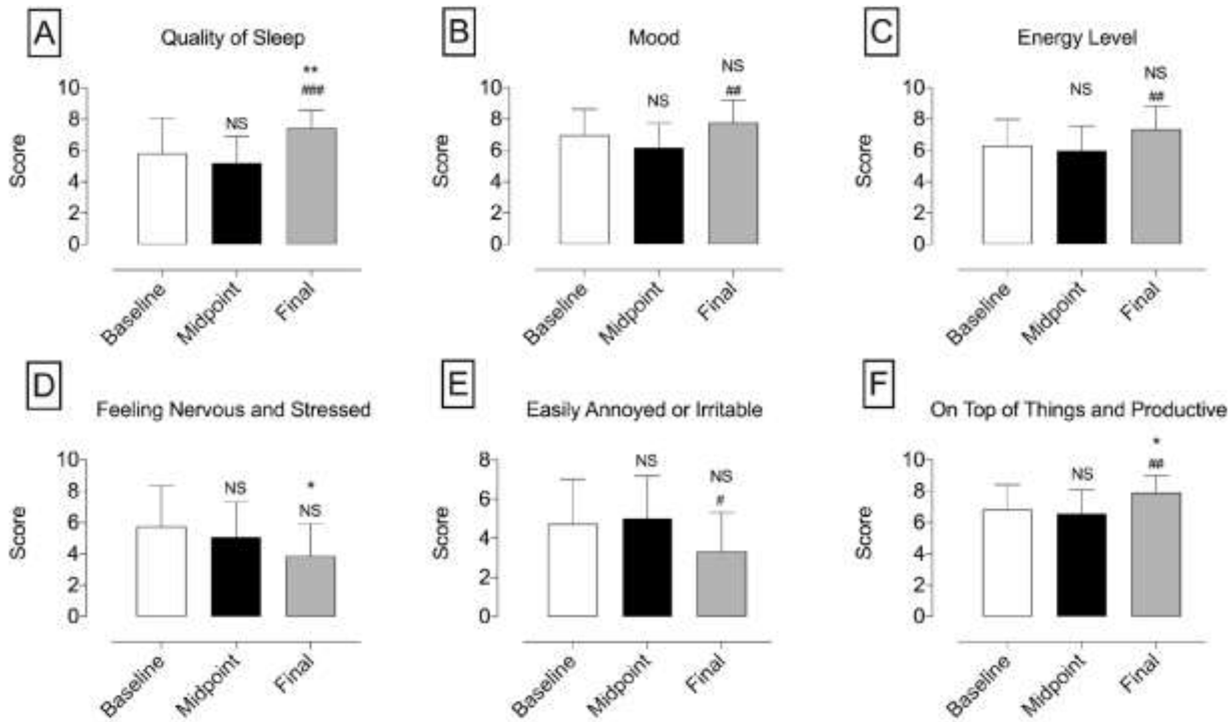

Figure 4 - Self-reported 10-point Likert scale. Quality of sleep (Panel A); Mood (Panel B); Energy levels (Panel C); Feeling of being nervous and stressed (Panel D); Feeling of being annoyed or irritable (Panel E); Feeling of being "on top of things" and productive (Panel F). NS: Not statistically significant. **p<0.05,* ***p<0.01* when compared to baseline evaluation, *##p<0.01, ###p<0.001* when compared to midpoint Evaluation. Ordinary One-Way Anova followed by Tukey's multiple comparisons test or Kruskal-Wallis test followed by Dunn's multiple comparisons test, where applicable (prism graphpad 8, La Jola USA).

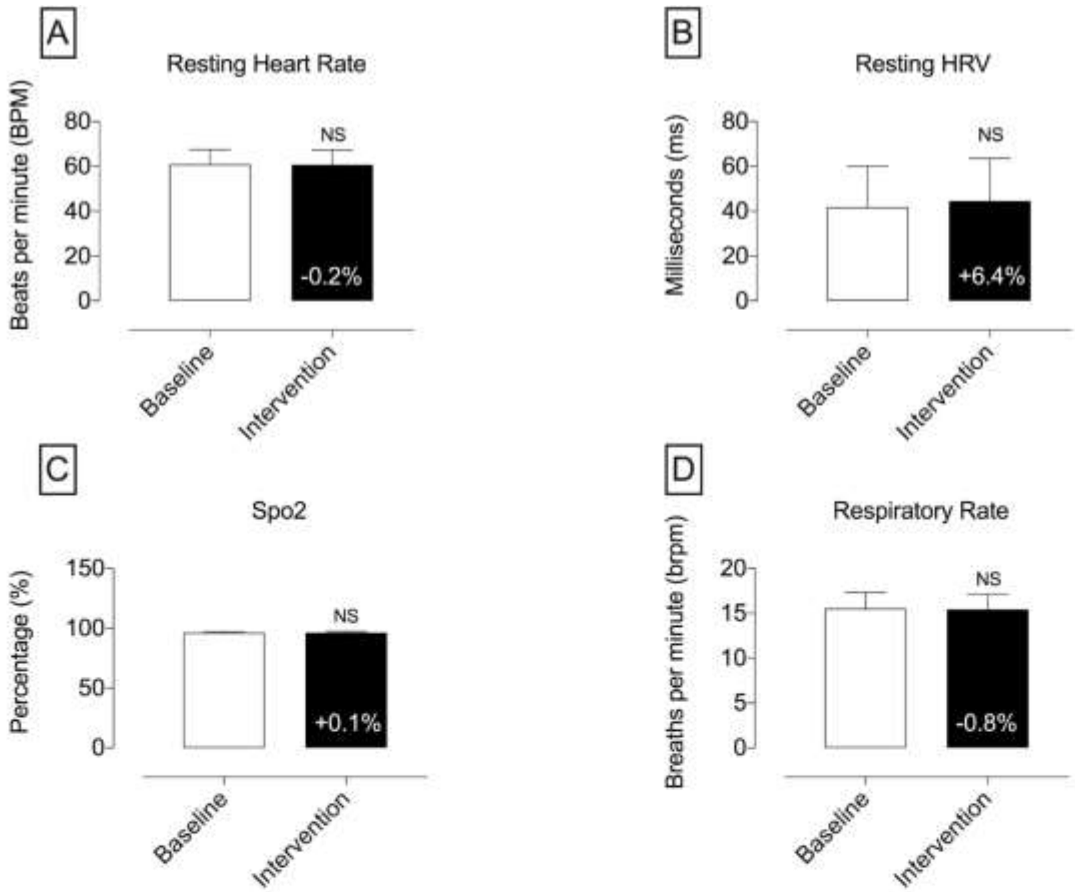

Figure 5 - Biostrap data. Resting heart rate (Panel A); Resting Heart rate variability (HRV) (Panel B); Peripheral capillary oxygen saturation (SpO_2) (Panel C); Respiratory rate (Panel D). NS: Not statistically significant. Unpaired or paired t test or Wilcoxon matched-pairs signed rank test, where applicable (prism graphpad 8, La Jola USA).

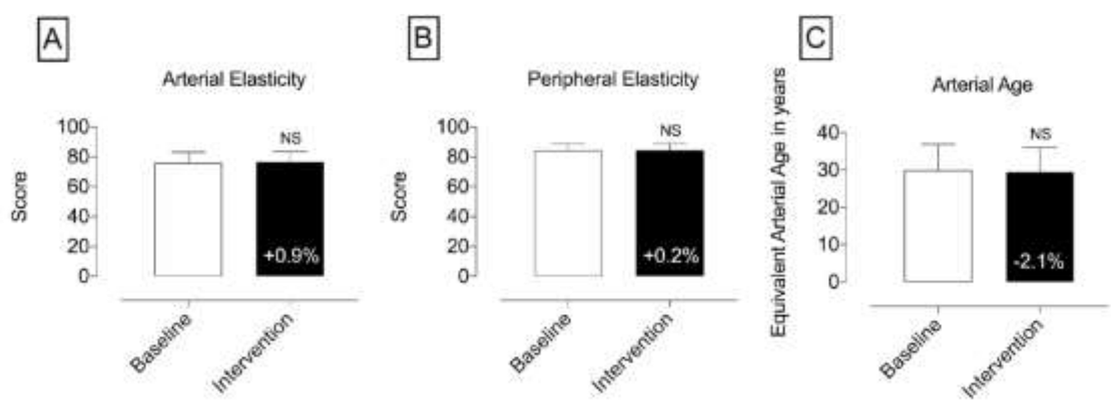

Figure 6 - Biostrap data. Arterial elasticity (Panel A); Peripheral elasticity (Panel B); Arterial age (Panel C). NS: Not statistically significant. Unpaired or paired t test or Wilcoxon matched-pairs signed rank test, where applicable (prism graphpad 8, La Jola USA).

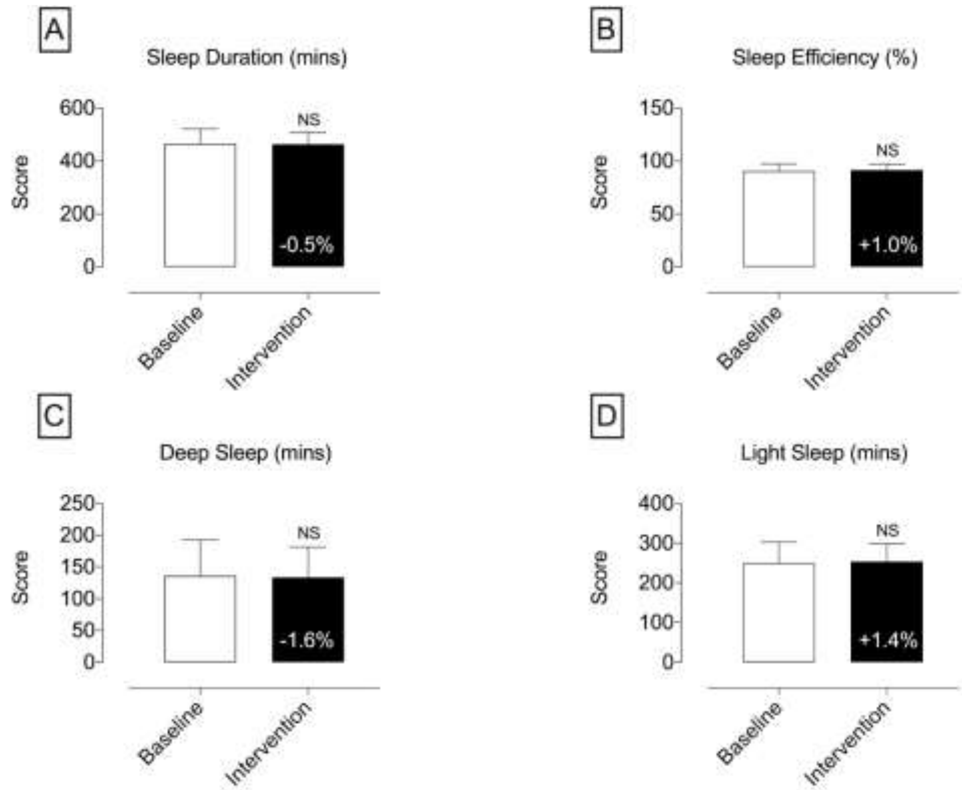

Figure 7 - Biostrap data. Sleep duration (Panel A); Seep efficiency (%) (Panel B); Deep sleep (Panel C); Light sleep (Panel D). NS: Not statistically significant. Unpaired or paired t test or Wilcoxon matched-pairs signed rank test, where applicable (prism graphpad 8, La Jola USA).

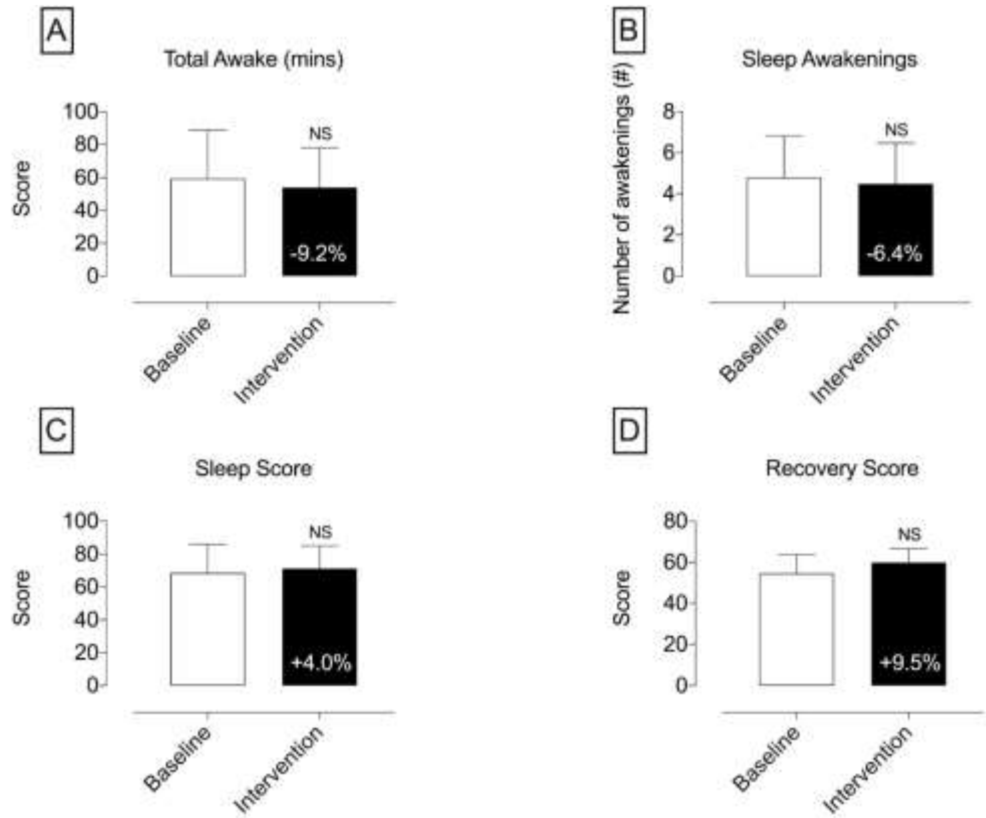

Figure 8 - Biostrap data. Total time Awake (Panel A); Sleep awakenings (Panel B); Sleep Score (Panel C); Recovery Score (Panel D). NS: Not statistically significant. Unpaired or paired t test or Wilcoxon matched-pairs signed rank test, where applicable (prism graphpad 8, La Jola USA).

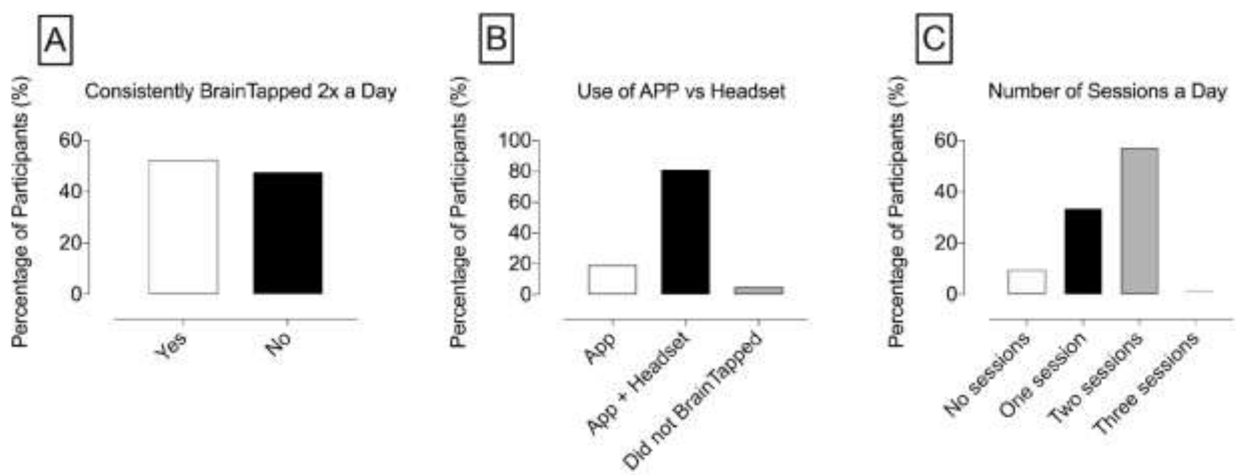

Figure 9 - Adherence to Braintapping during the intervention phase of study. Consistently BrainTapped twice (2x) a day during intervention phase (Panel A); Use of App versus Headset (Panel B); Number of Sessions a day (Panel C).

Study #12 - PhD Thesis in the postgraduate Program in Health Sciences, Laboratory of Experimental Neurosciences (LaNEX) of the University of South Santa Catarina, SC, Brazil. Preliminary data was selected for Special session poster presentation at the Ganepão Congress, SP, Brazil, July of 2024.

Association of Mediterranean Diet and Brainwave Entrainment in Major Depression: A Randomized, Blinded, Sham-Controlled Trial

Taynah de Oliveira Galassi[1,2]; Cíntia Renosto Bonetti[1]; Nicoly Cechinel da Rosa[1]; Fernanda Belle[1,2]; Larice Nienkotter[1,2]; Juliana Nazário[1]; Eduardo Stracke[1]; Gianluca Bianco[3,4]; Dario Boschiero[5]; Hiago Murilo de Melo[1,2]; Franciane Bobinski[1,2]; Francisco J. Cidral-Filho[1,2,3,6]; Daniel F. Martins[1,2,3].

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4. Istituto Di Formazione in Agopuntura E Neuromodulazione IFAN, Rome, Italy
5. BioTekna - Biomedical Technologies, Venezia, Italy.
6. Integrative Wellbeing Institute, Windermere, FL, USA.

Introduction

The Mediterranean diet (MD) has been shown to reduce depressive symptoms; however, its effects on Major depressive disorder (MDD) and related outcomes, such as generalized anxiety disorder, sleep quality, stress levels, and quality of life, remain underexplored. Brainwave entrainment (BWE) has also demonstrated efficacy in reducing clinical signs and symptoms associated with MDD but has not been studied specifically in this context. Furthermore, the present randomized controlled trial (RCT) is innovative, evaluating the effect of combining both treatments on MDD.

Objectives

To evaluate the effects of the association of a modified MD-based nutritional intervention and BWE protocol on reducing depression levels. Secondary outcomes included assessing these treatments' impact on resilience, perceived stress, anxiety (state-trait), capacity, quality of life, sleep quality, brainwave activity, body composition, prefrontal cortex hemodynamics, autonomic nervous system activity, and serum concentrations of MDD biomarkers.

Methods

This was a randomized, double-blind, controlled study conducted at the Experimental Neuroscience Laboratory, University of Southern Santa Catarina, Brazil. Fifty-one participants with MDD were randomly assigned to either the MD+Sham BWE group (n=27) or MD+BWE group (n=24). Participants received nutritional intervention (including

a psychiatric nutrition guide for MDD, educational videos, and weekly nutritional counseling) and daily 20-minute BWE sessions by 8 weeks (48 sessions in total). Sessions consisted of binaural beats and isochronic tones within the alpha (8-12 Hz), theta (4-7 Hz), or delta (0.5-3 Hz) ranges. Sham BWE sessions were conducted within the beta range (13-30 Hz). Clinical assessments were conducted on days 0 (pre) and 8 weeks (post).

Results
Both MD and BWE treatments effectively reduced depression, trait anxiety, state anxiety, and perceived stress while also improving sleep quality and components of quality of life. Improvements in resilience capacity, the mental health component, specific HRV parameters such as SDNN, theta and gamma wave modulation, and serum leptin reduction were observed exclusively when MD was combined with BWE.

Conclusion
Both MD and BWE significantly reduced levels of depression, anxiety, and perceived stress, while improving quality of life, sleep quality, and resilience capacity in individuals with MDD. The combination of MD with BWE produced more pronounced effects. These findings suggest that MD and BWE may serve as adjuvant and effective integrative tools for managing MDD.

Trial registration: RBR-2t5svsq on ReBEC.

Figures

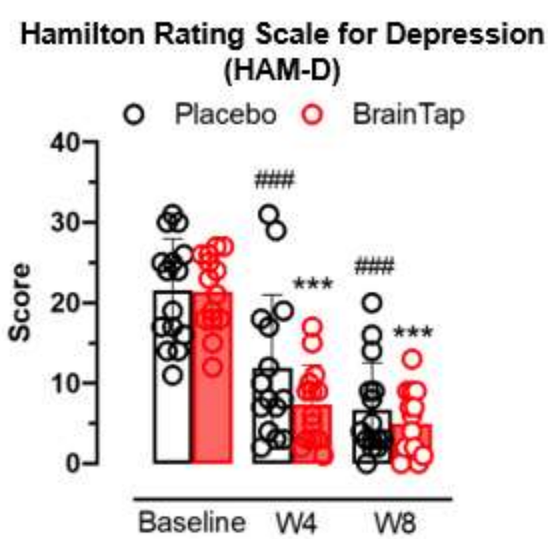

Figure 1 - Hamilton Rating Scale for Depression (HAM-D).

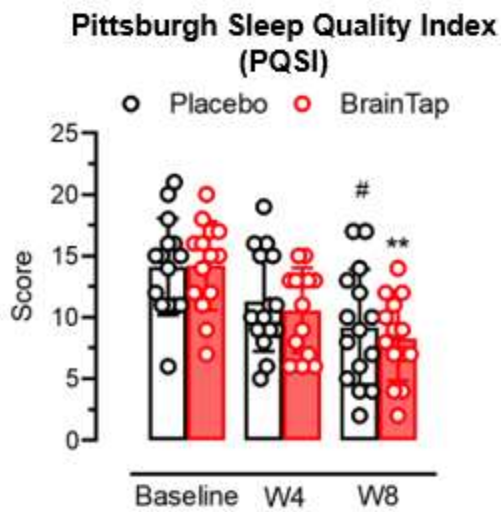

Figure 2 - Pittsburg Quality of Sleep Index (PQSI).

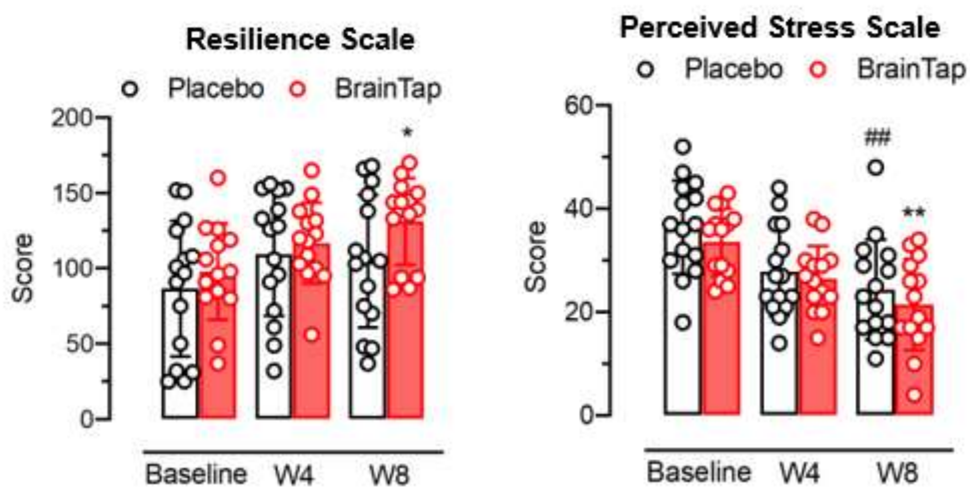

Figure 3 - Resilience Scale and Perceived Stress Scale.

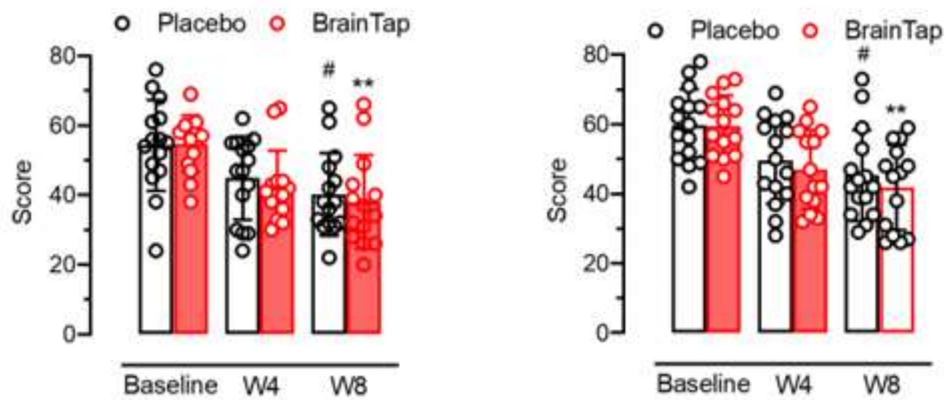

Figure 4 - State-Trait Anxiety Iventory (STAI)

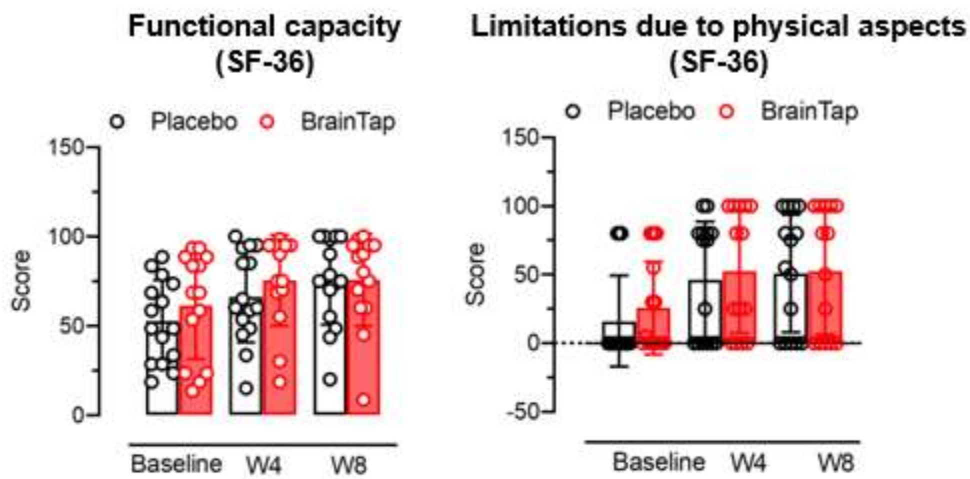

Figure 5 - Medical Outcomes Short-Form Health Survey (SF-36)

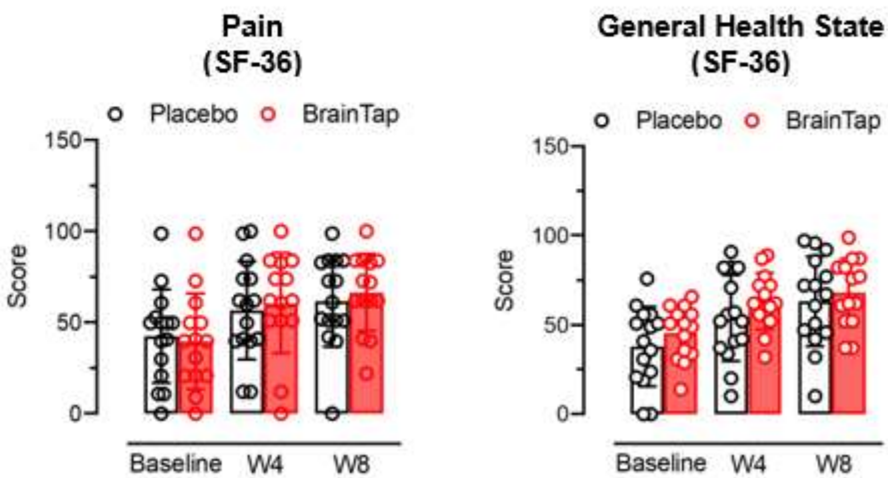

Figure 6 - Medical Outcomes Short-Form Health Survey (SF-36)

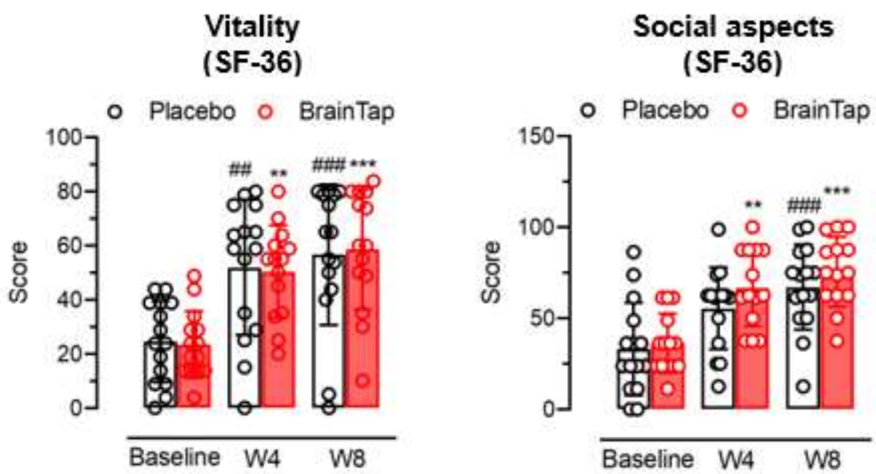

Figure 7 - Medical Outcomes Short-Form Health Survey (SF-36)

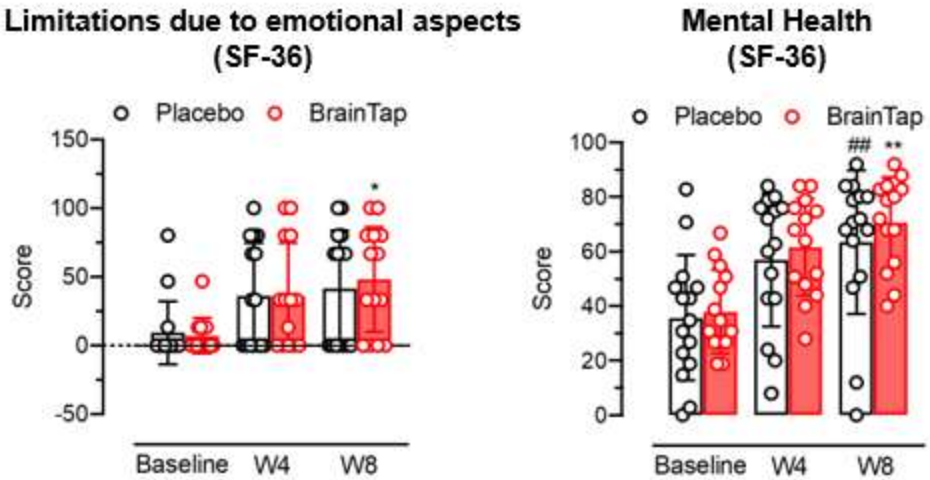

Figure 8 - Medical Outcomes Short-Form Health Survey (SF-36)

Study #13 – Master’s degree dissertation in the postgraduate Program in Health Sciences of the University of Southern Santa Catarina, SC, Brazil. Conducted at the Physiotherapy School Clinic and the Medical Specialty Clinic (AMEI) of the University of Southern Santa Catarina, SC, Brazil.

The effects of audiovisual brainwave entrainment on pain, power of brainwaves and quality of life of patients with Fibromyalgia: A Randomized Clinical Trial.

The study was conducted at the Physiotherapy School Clinic and the Medical Specialty Clinic (AMEI) of the University of Southern Santa Catarina, Pedra Branca campus, Florianopolis, Santa Catarina, Brazil.

Sample

Patients residing in the Greater Florianópolis region aged between 18 and 80 years, diagnosed with Fibromyalgia and undergoing pharmacological treatment prescribed by their attending physician.

Intervention

The intervention consisted of 8 weeks:
- 24 20-minute sessions of Audiovisual Brainwave Entrainment with alpha waves (with the Braintap Headset), and
- 16 20-minute sessions of Auditory Brainwave Entrainment with theta waves using headphones at home (with the Braintap APP).

Results

• Decrease in pain (Visual Analogue Scale) (Fig. 1)
• Decrease in Emotional Limitations (Fig. 2)
• Increased Alpha activity in AF3 and AF4 EEG - roughly located at the upper forehead and represent the left and right prefrontal cortex, respectively (Fig. 3)

Please note that the pharmacological intervention is effective, although the association of Brainwave Entrainment significantly increases the effects.

Figures

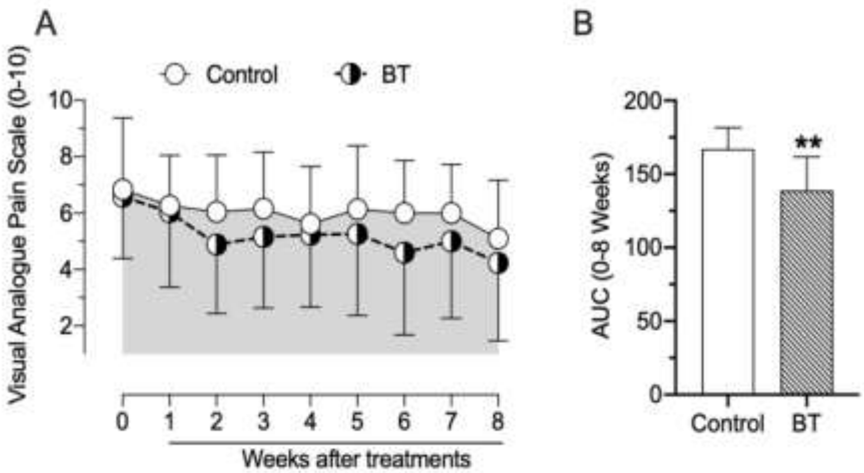

Figure 1 - Visual analogue Scale (VAS) to evaluate PAIN.

Figure 2 - Emotional Limitations. The higher the number the lesser emotional limitation.

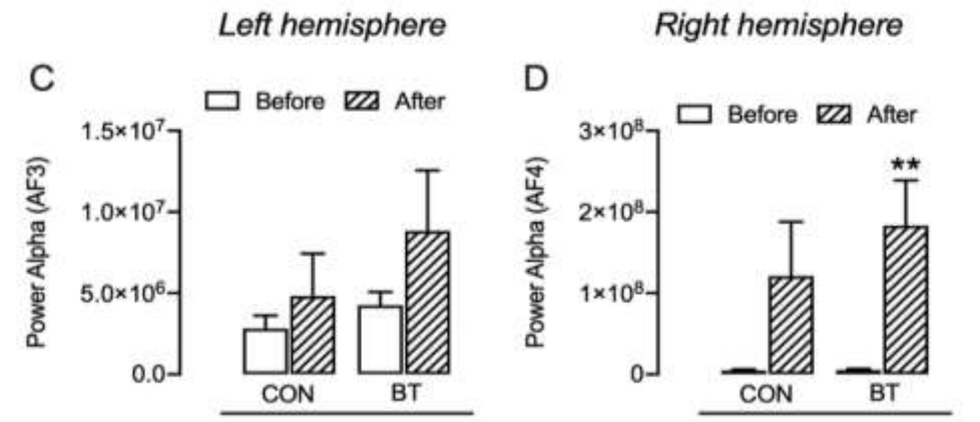

Figure 3 - Alpha activity in AF3 and AF4 EEG.

Study #14 - PhD Thesis, conducted at the Federal University of Santa Catarina SC, Brazil. Published at the Exploration of Neuroprotective Therapy journal. 2023;3:481-96. doi:10.37349/ent.2023.00064

Effects of acoustic neurostimulation in healthy adults on symptoms of depression, anxiety, stress and sleep quality: a randomized clinical study

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Aim
To evaluate the application of an acoustic neurostimulation program with binaural beats and isochronic tones isolated or in association, and its effects on sleep, depression, anxiety, and stress in healthy workers.

Methods
A randomized, single-blind, parallel-group clinical trial, using acoustic neurostimulation with binaural beats, isochronic tones, or a combination of these in the 10 Hz range (alpha) performed with daily 20-minute sessions for 21 days. Changes in brainwave patterns were assessed by electroencephalogram (EEG). Psycho-emotional state was assessed with the Depression, Anxiety and Stress Scale 21 Items (DASS21), and sleep quality with the Pittsburgh Sleep Quality Index (PSQI). In addition, salivary cortisol levels were evaluated as a biomarker of stress.

Results
The data revealed distinct patterns of brainwave modulation via brainwave entrainment (BWE) techniques. Binaural beats and isochronic tones, alone and in combination, effectively increased alpha brainwaves in the temporoparietal region. However, when assessing theta brainwave frequencies in the same region, only binaural beats showed a significant effect. Furthermore, in the prefrontal cortex, an elevation in beta waves was exclusively observed with the use of binaural beats. These findings underscore the specificity of BWE techniques on different brainwave frequencies and regions. The study demonstrated marked improvements in several symptoms related to stress, depression, anxiety, assessed by psychometry with DASS-21 and related to sleep quality assessed by the PSQI.

Conclusions

These results indicate that 10 Hz acoustic neurostimulation in the alpha range, whether through binaural beats, isochronic tones, or a combination of both, can significantly influence brainwave patterns and intensity. Notably, participants exhibited decrease in symptoms of stress, depression, and anxiety, coupled with improved sleep quality. These data suggest that alpha acoustic neurostimulation holds promise as an effective intervention for bolstering mood, mental health, and overall emotional wellbeing.

Trial Registration: RBR-10yj42dj

Figures

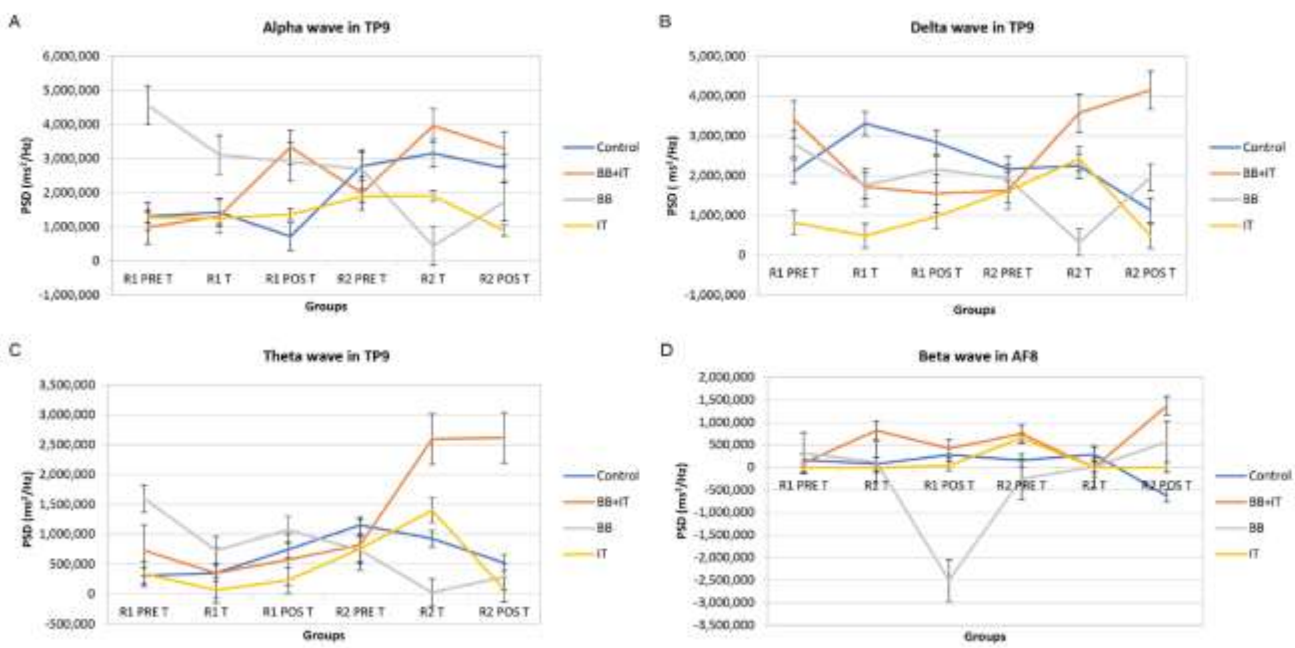

Figure 1 - Effects of acoustic neurostimulation with BB and IT alone or associated (BB + IT) on electrophysiological responses evaluated in the EEG. PDS of alpha (A), delta (B), theta (C), and beta (D) waves. Statistical significance level: $P \leq 0.100$ (*), $0.01 < P < 0.05$ (**), $P < 0.01$ (***). PDS: power spectral density; R1 PRE T: round 1, pre-workout (application); R1 T: round 1, training; R1 POS T: round 1, post-workout; R2 PRE T: round 2, pre-workout; R2 T: round 2, training; R2 POS T: round 2, postworkout.

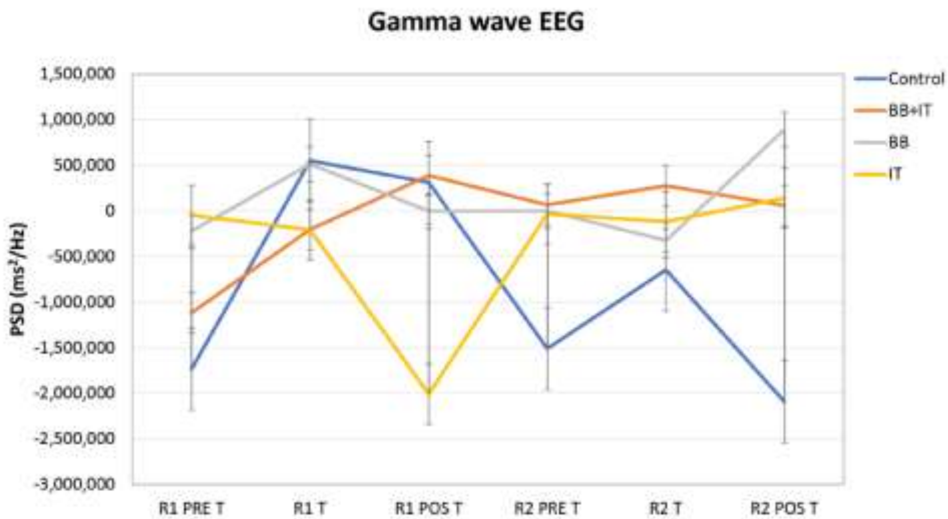

Figure 2 - Effects of acoustic neurostimulation with BB and IT alone or associated (BB + IT) on electrophysiological responses evaluated in the EEG. PDS of gamma waves. Statistical significance level: $P \leq 0.10$ (*), $0.01 < P < 0.05$ (**), $P < 0.01$ (***)

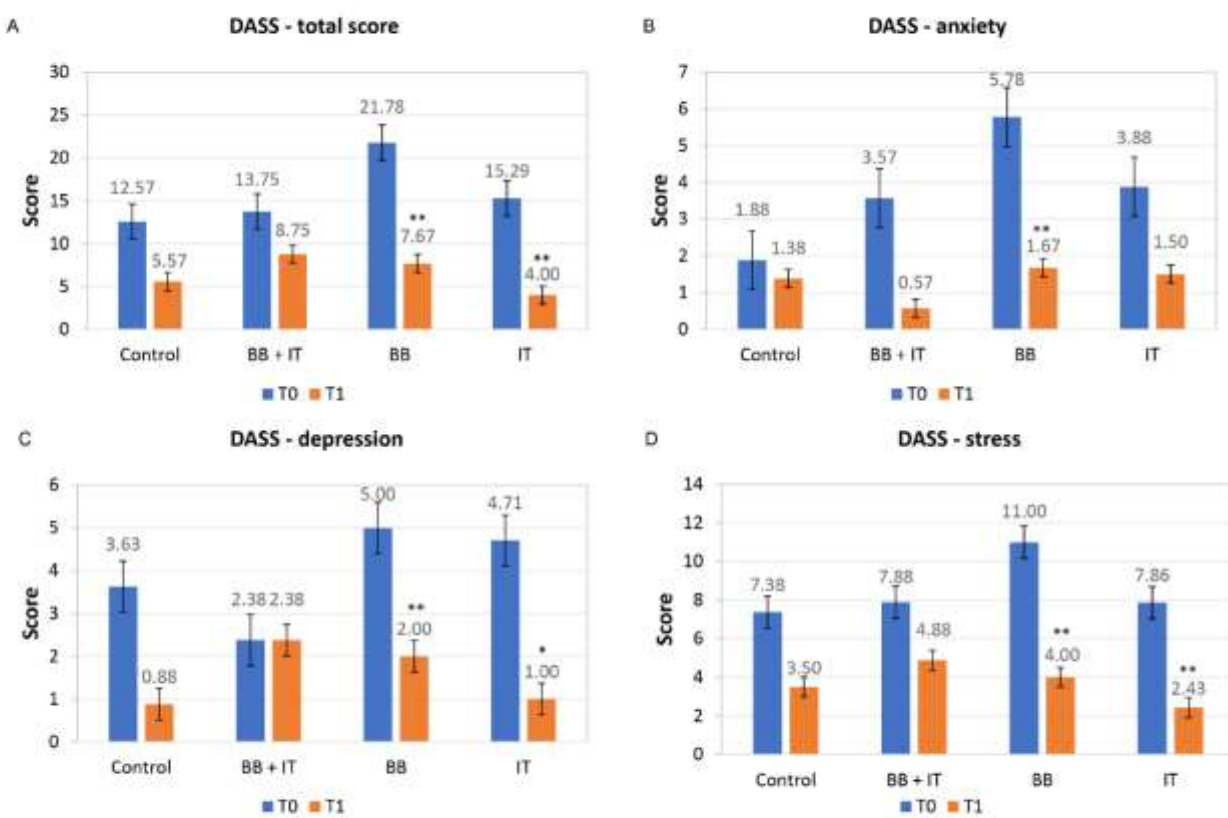

Figure 3 - Effects of acoustic neurostimulation with BB and IT alone or associated (BB + IT) on total score (A) and symptoms of anxiety (B), depression (C), and stress (D) evaluated by DASS-21 test. Statistical significance level: $P \leq 0.10$ (*), $0.01 < P < 0.05$ (**), $P < 0.01$ (***)

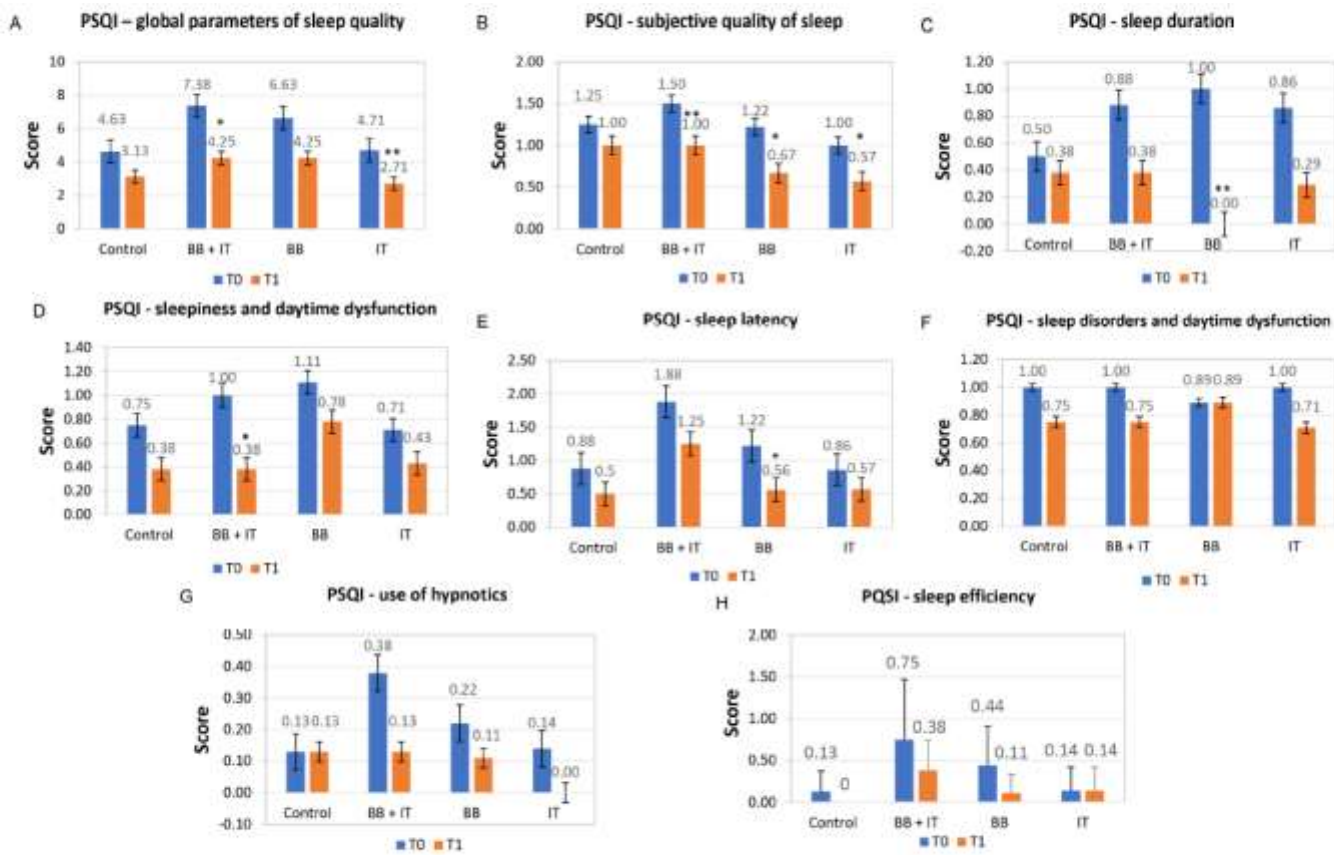

Figure 4 - Effects of acoustic neurostimulation with BB and IT alone or associated (BB + IT) on global parameters of sleep quality (A), subjective quality of sleep (B), sleep duration (C), sleepiness and daytime dysfunction (D), sleep latency (E), sleep disorders and daytime dysfunction (F), use of hypnotics (G), and sleep efficiency (H) using the PSQI. Statistical significance: $P \leq 0.10$ (*), $0.01 < P < 0.05$ (**), $P < 0.01$ (***)

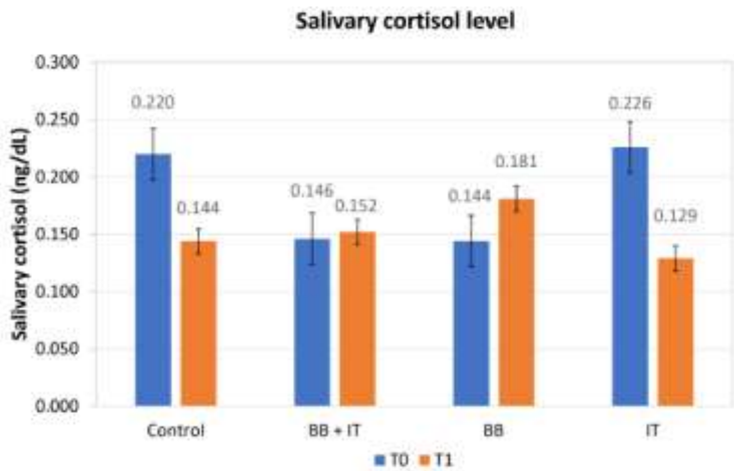

Figure 5 - Effects of acoustic neurostimulation with BB and IT alone or associated (BB + IT) on salivary cortisol levels. Statistical significance level: $P \leq 0.10$ (*), $0.01 < P < 0.05$ (**), $P < 0.01$ (***)

Study #15 - Internal study conducted with BioStrap & Somavedic team members. Conducted Online in 2021).

Effect of Brainwave Entrainment and EMF reduction technology on quality of sleep, mood, and heart rate variability: pilot study with healthy individuals.

Aim
The main objective of this study was to evaluate the effect of Brainwave Entrainment and EMF reduction technology, either alone or combined on quality of sleep and mood.

Methods
The study was conducted over the course of six (6) weeks. Sample size consisted of 20 volunteers who were not making use of analgesics, anti-inflammatories, or sleep aids at least seven (7) days prior to, as well as during the study, and who had no hearing disabilities. Sleep and mood were evaluated through the Pittsburgh Quality of Sleep Index (PQSI), Profile of Mood States (POMS) questionnaire, and the Depression, Anxiety and Stress Scale (DASS-21). Participants were asked to undergo two (2) Braintap sessions a day (Braintap Headset,New Bern - NC - USA) and be in close proximity to a Somavedic™ EMF reduction technology during the day and particularly during sleep for the duration of the study.

Results
There was a statistically significant decrease in stress and depression scores ($p<0.05$), and a decrease in anxiety, however it was not statistically significant ($p=0.0003$). The intervention was also effective to improve mood as observed by a statistically significant increase ($p<0.05$). There was also a statistically significant increase in Quality of Sleep (PQSI total score, $p<0.05$), as well as on sub scales II (sleep latency), III (sleep duration), V (sleep disturbance), and VII (daytime dysfunction); positive results in sub scales I (subjective sleep quality) and IV (sleep efficiency), although not statistically significant ($p=0.1981$ and $p=0.3122$,respectively); finally, on Subscale VI (use of sleep medication), one participant started making use of sleep aids, negatively affecting results ($p=0.6811$).

Conclusion
Overall, our results indicate positive effects of Brainwave Entrainment and EMF reduction technology on quality of sleep, stress, depression, and mood.

Figures

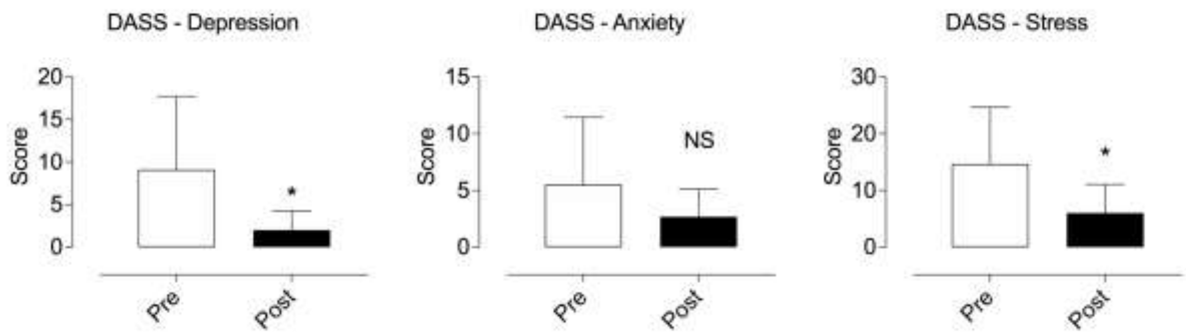

Figure 1 - Depression, Anxiety and Stress Scale (DASS-21). Lower scores indicate improvement. NS: Not statistically significant. *p<0.05 when compared to baseline evaluation. Paired t-test analysis (prism graphpad 9, La Jola USA).

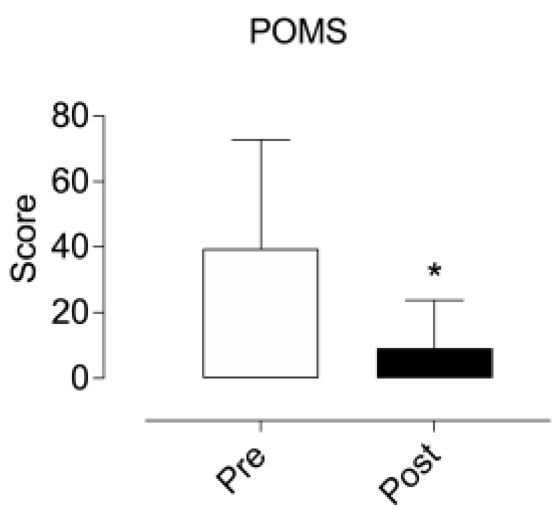

Figure 2 - Profile of Mood States (POMS). Lower scores indicate less disturbances to mood, hence, better overall mood. NS: Not statistically significant. *p<0.05 when compared to baseline evaluation. Paired t-test analysis (prism graphpad 9, La Jola USA).

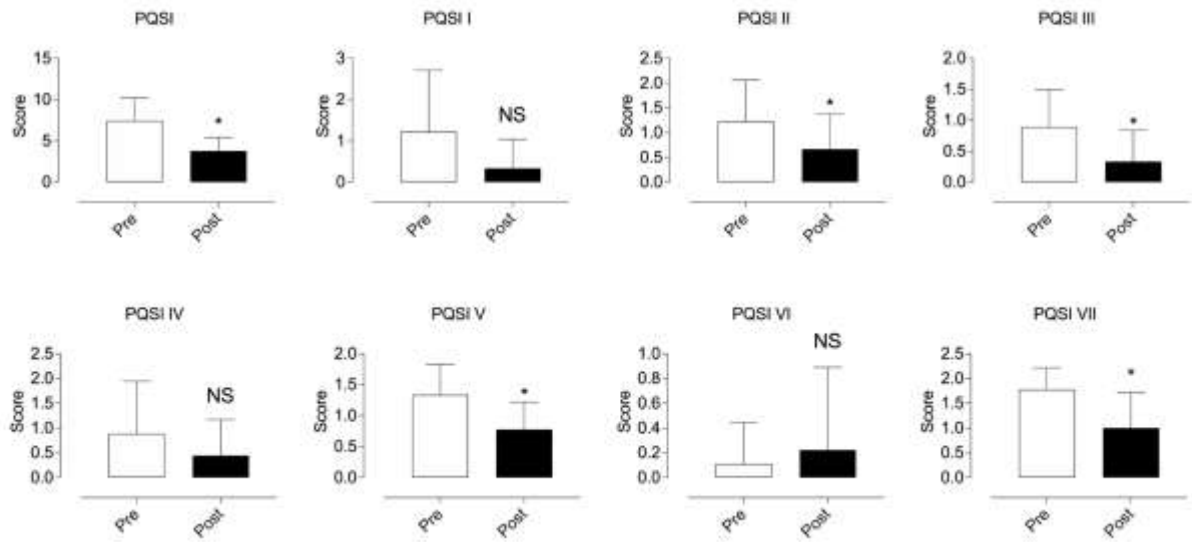

Figure 3 - Pittsburgh Quality of Sleep Index (PQSI). Lower scores indicate less disturbances to sleep, hence better quality of sleep. Global PSQI Score (PQSI); Component 1 (PQSI I): Subjective sleep quality; Component 2 (PQSI II): Sleep latency; Component 3 (PQSI III): Sleep duration; Component 4 (PQSI IV): Sleep efficiency; Component 5 (PQSI V): Sleep disturbance; Component 6 (PQSI VI): Use of sleep medication; Component 7 (PQSI VII): Daytime dysfunction. NS: Not statistically significant. *p<0.05 when compared to baseline evaluation. Paired t-test analysis (prism graphpad 9, La Jola USA).

Study #16 - PhD thesis of the Post Graduate Program in Health Sciences at the University of Southern Santa Catarina, SC, Brazil. Presented virtually at the 3d International Conference on Cognitive and Behavioral Neurosciences (Sep 13-14, 2023 at Barcelona, Spain).

The effects of neuromodulation through brainwave entrainment on pain in women with fibromyalgia: a randomized controlled clinical trial with Follow-Up

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6. Post-Graduate Program in Medical Sciences, School of Medicine, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, Rio Grande do Sul, Brazil.
7. Laboratory of Pain and Neuromodulation, Hospital de Clínicas de Porto Alegre (HCPA), Porto Alegre, Rio Grande do Sul, Brazil
8. Laboratory of Neuromodulation and Center for Clinical Research Learning, Physics and Rehabilitation Department, Spaulding Rehabilitation Hospital, Boston, Massachusetts, United States of America.
9. Technische Universität München, TUM School of Medicine and Health, Department Health and Sport Sciences, Associate Professurship for Conservative and Rehablitative Orthopedics, Germany.
10. Department for Medical Professions, Diploma Hochschule, Bad Sooden-Allendorf, Germany.
11. Integrative Wellbeing Institute, Windermere, Florida, United States of America.

Background

Fibromyalgia is a syndrome characterized by chronic, widespread pain. Its pathogenesis is unknown, but cumulative evidence indicates fibromyalgia is associated with alterations in brain surface wave frequencies as well as increases in oxidative stress and BDNF levels. This study investigated the effects of brainwave entrainment (BWE) vs. music therapy for managing fibromyalgia in women.

Methods

Eighty-four female patients with fibromyalgia were randomly assigned to two groups, namely music therapy (n= 42) or BWE administered using a BrainTap headset (n= 42). The music therapy and BWE groups were treated for 20 minutes daily, five times a week, over eight weeks. Visual analog scale (VAS) for pain, McGill pain questionnaire (MPQ), fibromyalgia impact questionnaire (FIQ), and SF-36 quality of life questionnaire were applied at baseline, during the treatment, and post-intervention with a six-month follow-up. Biochemical analyses and the Hamilton Depression and Anxiety Rating Scale (HAM-A and HAM-D) were performed at baseline and at the conclusion of the treatment. Data were evaluated using one- or two-way analysis of variance (ANOVA), followed by the Student-Newman-Keuls or Bonferroni test.

Results

BWE reduced VAS scores compared to the musicotherapy group. Moreover, BWE improved parameters related to quality of life, depression, anxiety and oxidative stress and reduced BDNF levels in patients with fibromyalgia, an effect also observed with musicotherapy.

Conclusion

BWE delivered through the BrainTap headset has the potential to alleviate pain and improve the quality of life in women with fibromyalgia. This effect appears to be related to oxidative stress and BDNF levels reduction.

Trial Registration: RBR-67c7n8g

Figures

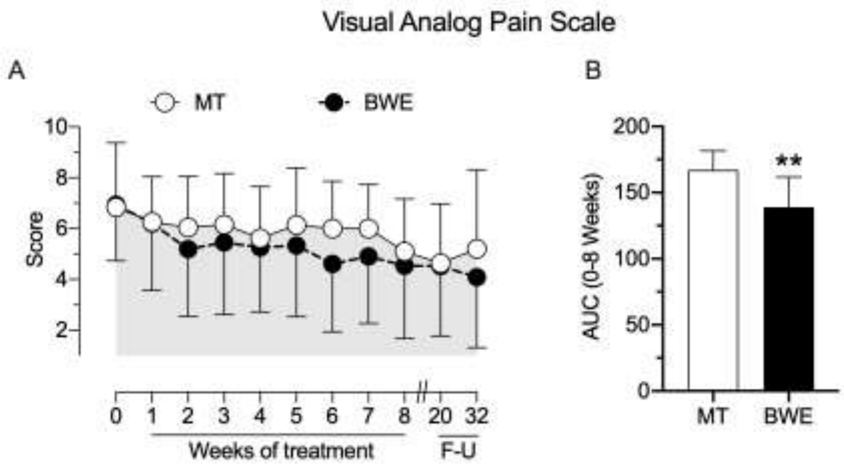

Figure 1 - Pain assessment using the Visual Analogue Scale (VAS). Assessment in weeks of mean pain scores (panel A). Analysis of the area under the curve for the entire period evaluated (panel B). Weeks 20 and 32 were the follow-up after the end of treatment, corresponding to 3 and 6 months. In panel B, the ** indicates the statistical difference of the BWE group when compared to the MT, with **$p < 0.0065$.

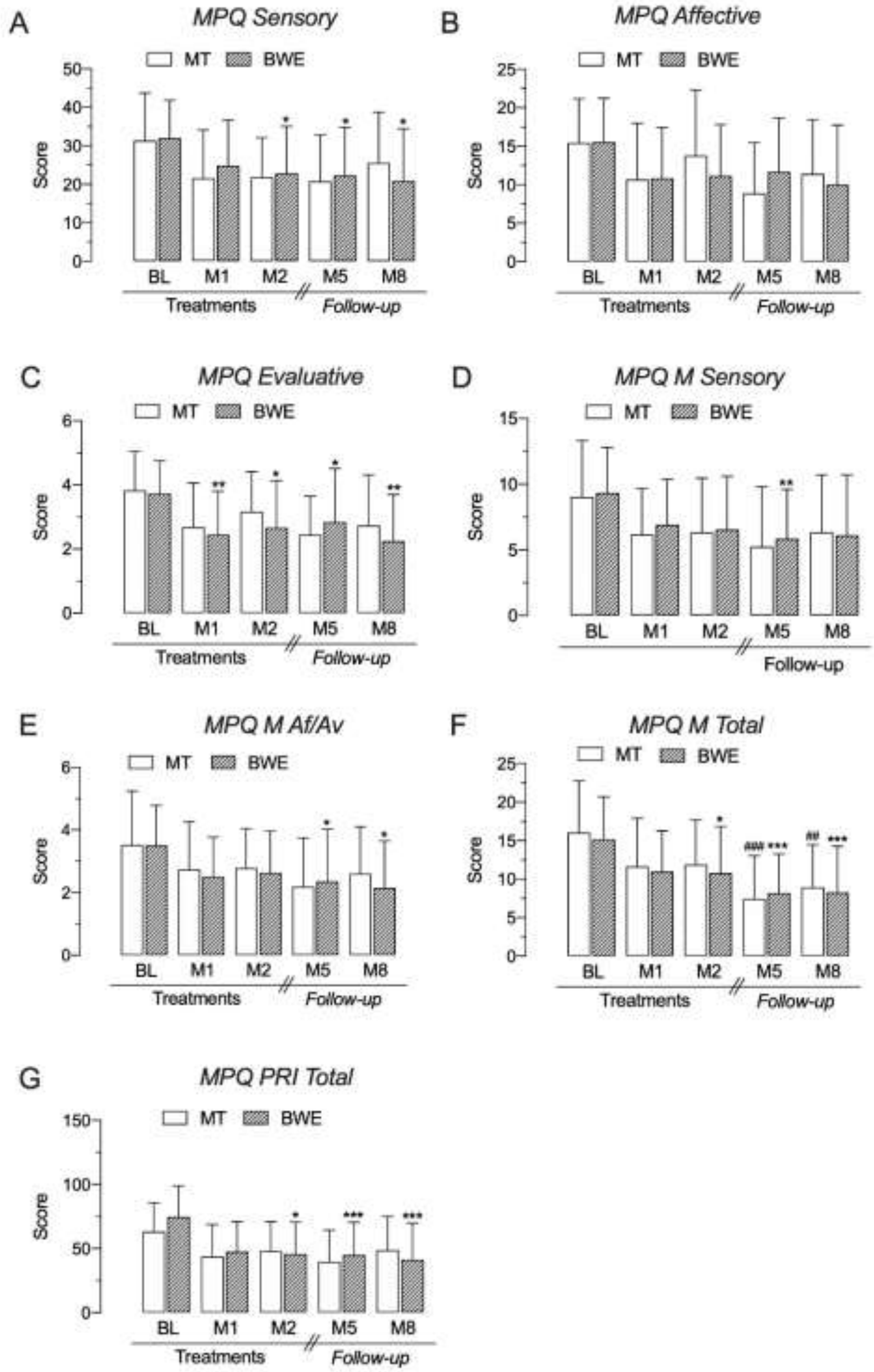

Figure 2 - Mcgill pain questionnaire. Assessment was performed before (baseline) and after M1 (one month) and M2 (two months) of treatment, as well as at M5 (three months) and M8 (six months) after the end of

treatment for follow-up. The domains evaluated were: A) sensory pain B) affective pain C) evaluative pain D) Miscellany sensory pain E) miscellany affective/evaluative F) miscellany total and G) Total score. In all graphs the * indicates the statistical difference of the BWE group when compared to their baseline values, with *p < 0.05; **p < 0.01 and ***p < 0.001. The # indicates the statistical difference of the MT group when compared to their baseline values, with #p < 0.05; ##p < 0.01.

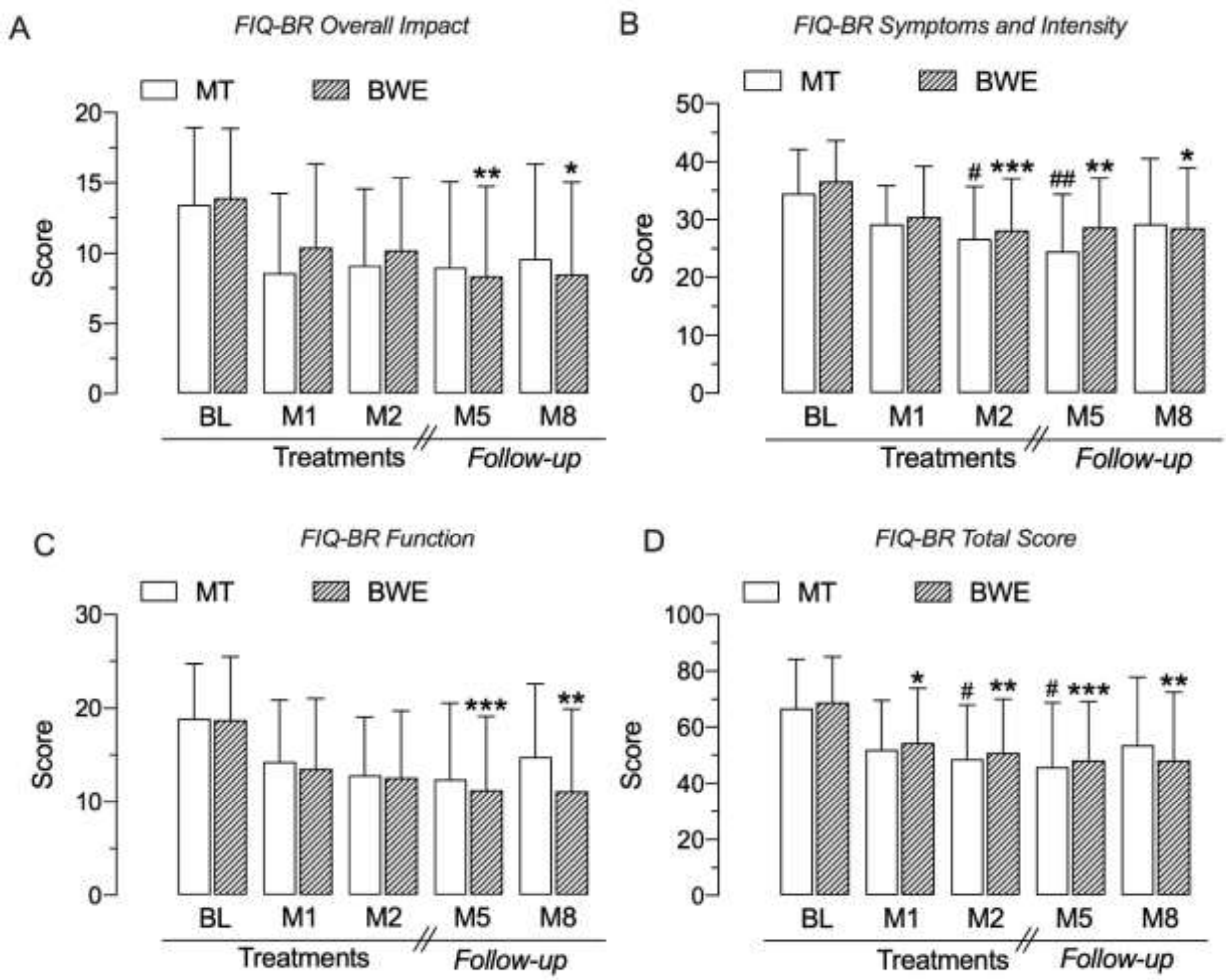

Figure 3 - Assessment of quality of life using the Revised Fibromyalgia Impact Questionnaire for Brazil (FIQR-Br). Assessment was performed before (baseline) and after M1 (one month) and M2 (two months) of treatment, as well as at M5 (three months) and M8 (six months) after the end of treatment for follow up. The domains evaluated: A) overall impact B) symptoms and intensity C) function and D) total score. In all graphs the * indicates the statistical difference of the BWE group when compared to their baseline values, with *p < 0.05; **p < 0.01 and ***p < 0.001. The # indicates the statistical difference of the MT group when compared to their baseline values, with #p < 0.05; ##p < 0.01.

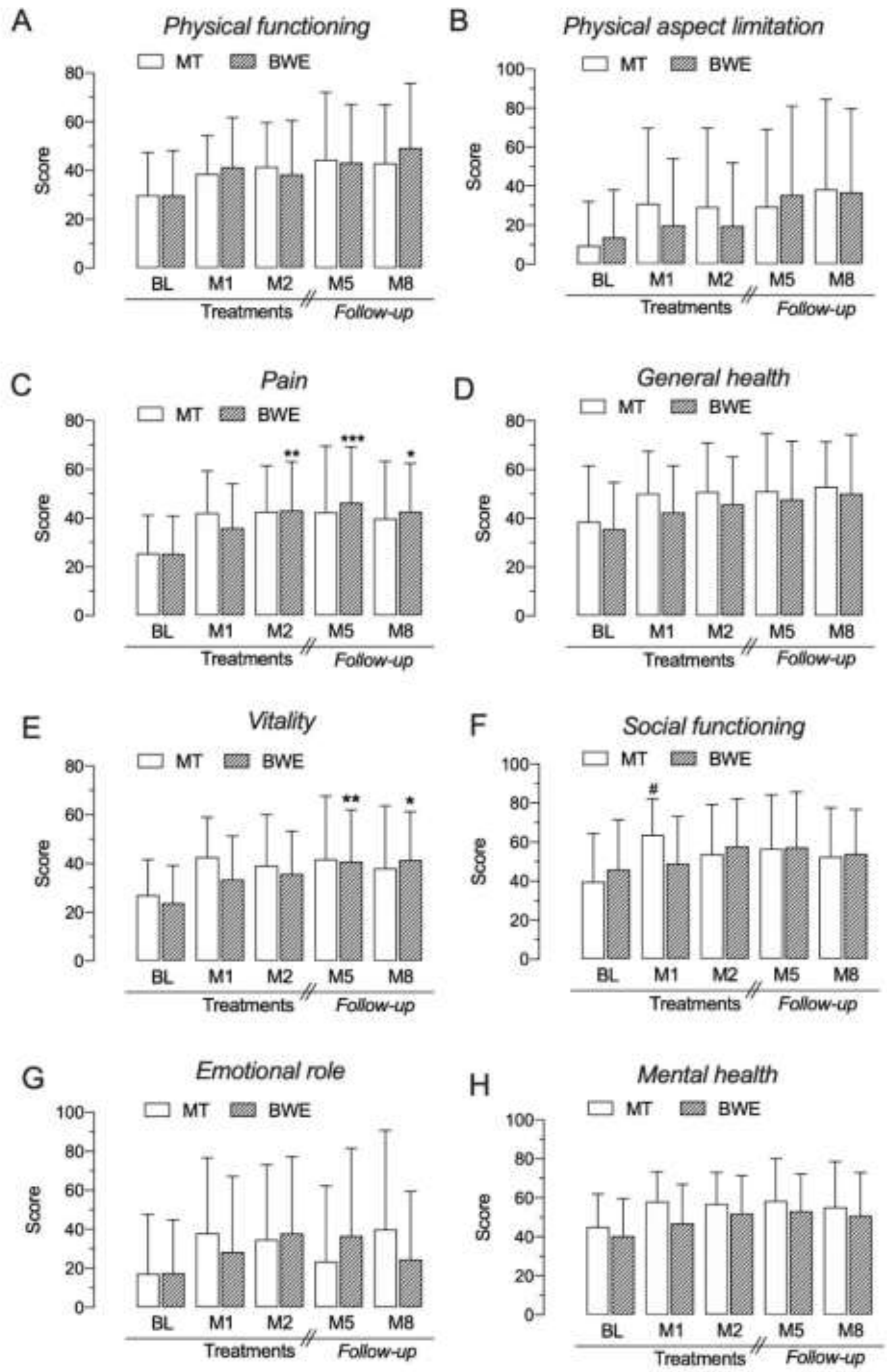

Figure 4 - Assessment of quality of life using the SF-36 questionnaire. Assessment was performed before (baseline) and after M1 (one month) and M2 (two months) of treatment, as well as at M5 (three months) and M8 (six months) after the end of treatment for follow-up. The domains evaluated were: A) physical

functioning B) physical aspect limitation C) pain D) general health E) vitality F) social functioning G) emotional role and H) mental health. In all graphs the * indicates the statistical difference of the BWE group when compared to their baseline values, with *p < 0.05; **p < 0.01 and ***p < 0.001. The # indicates the statistical difference of the MT group when compared to their baseline values, with #p < 0.05; ##p < 0.01.

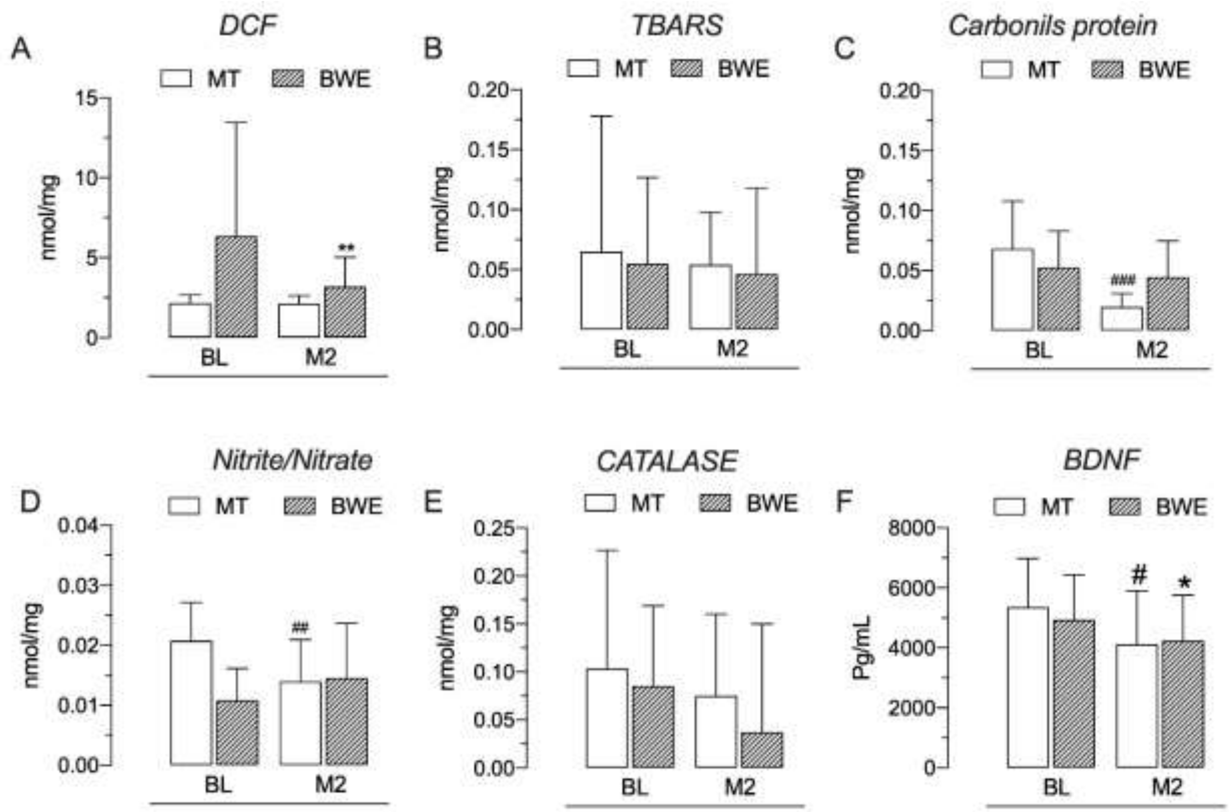

Figure 5 - Effect of the BWE protocol on BDNF biomarkers and oxidative stress. Asessment was performed before (baseline) and after M1 (one month) and M2 (two months) of treatment, as well as at M5 (three months) and M8 (six months) after the end of treatment for follow-up. The domains evaluated: A) DCF - 2′,7′- dichlorofluoresceina B) TBARS - Thiobarbituric acid reactive species C) carbonils protein D) nitrite/nitrate E) catalase and F) BDNF - Brain-derived neurotrophic factor. In all graphs the * indicates the statistical difference of the BWE group when compared to their baseline values, with *p < 0.05; **p < 0.01. The # indicates the statistical difference of the MT group when compared to their baseline values, with #p < 0.05; ##p < 0.01.

Study #17 – Conducted in the Laboratory of Experimental Neurosciences (LaNEX) at the University of Southern Santa Catarina (UNISUL), Brazil. Presented at the 2nd world Congress Integrative Medicine and Health in Rome at the Workshop Integration of Brainwave Entrainment and Electroacupuncture: Effects on Frontal Cortex Hemodynamics and Autonomic Balance (September 21 of 2023).

Effects of Brainwave Entrainment on Autonomic Balance and Prefrontal Cortex Hemodynamics

Background

Scientific evidence has demonstrated the importance of inhibitory modulation on the prefrontal cortex (PFC). The use of auditory stimuli to induce specific brain states and their application for a variety of measures of measures of mental well-being, has been a topic widely explored in the academic literature.

Methods

This study has a quasi-experimental design and involver 47 health students (male and female >18 years old). It was conducted at the Laboratory of Experimental Neuroscience - University of Southern Santa Catarina (UNISUL), Brazil. Baseline assessments were performed 10 min prior treatment, then a 20-min alpha waves BrainTap session was perfomed with the BrainTap headset, followed by re-assessment. PPG Stress Flow and HEG devices from BioTekna were used for assessments.

Results

The PPG Stress flow analysis (Fig 1) showed a statistically significant reduction in beats per minute (BPM), an increase in SDNN, RMSSD, Total Power and VLF power. The HEG analysis showed a statistically significant reduction in Cerebral Blood Flow in the PFC.

Conclusions

Acute treatment (one session) with BrainTap improves heart rate variability parameters and balances autonomic activity. Furthermore, an inhibitory effect on the prefrontal cortex was observed.

Figures

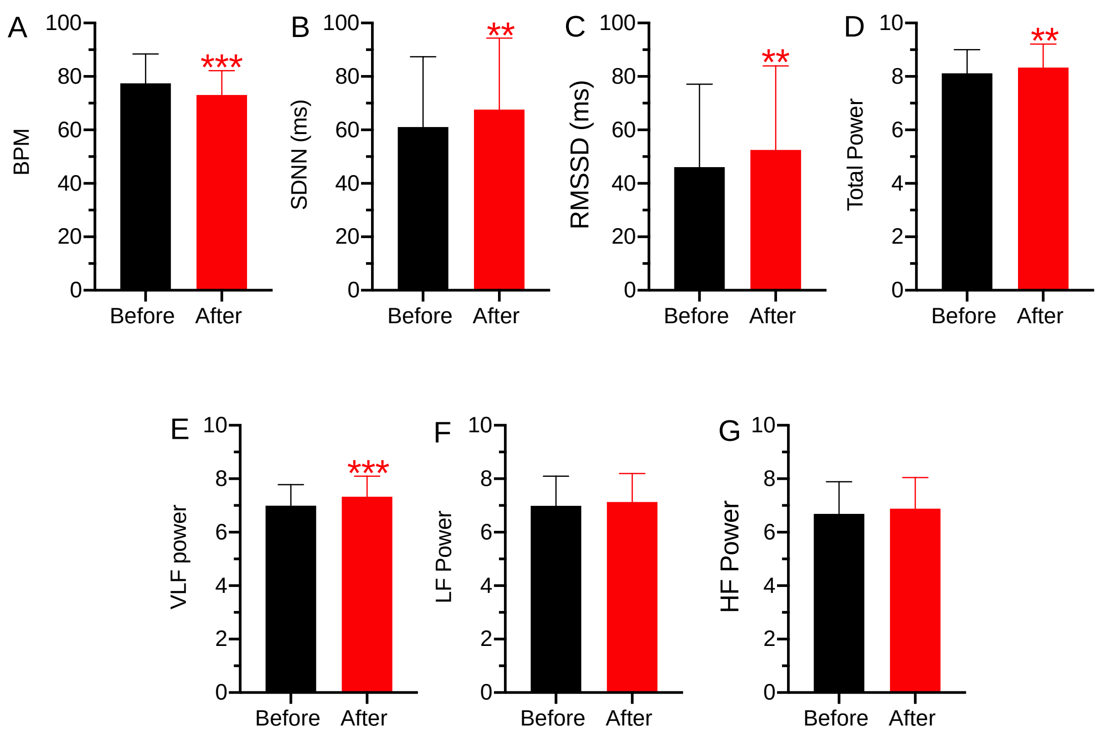

Figure 1 - Assessment of autonomic nervous system activity with PPG Stress Flow. *p<0.05 when compared with baseline evaluation.

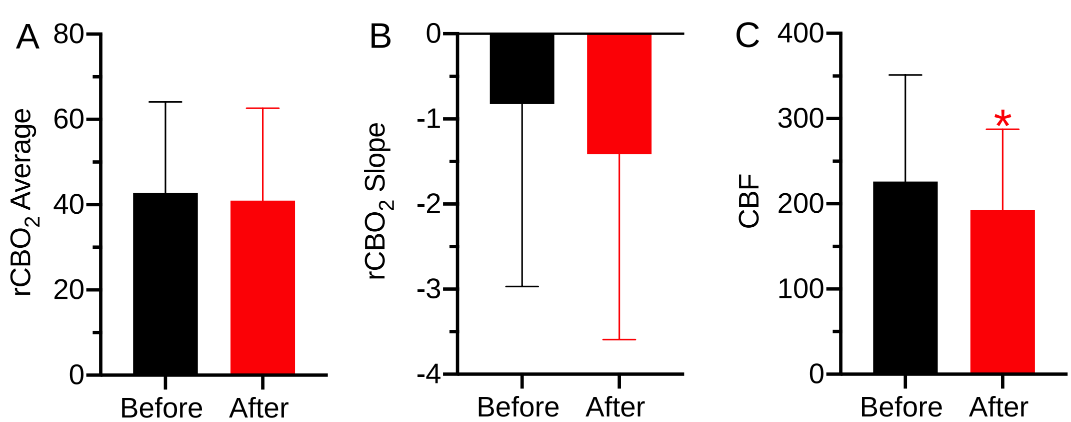

Figure 2 - Assessment of prefrontal cortex activity with HEG. *p<0.05 when compared with baseline evaluation.

Study #18 – Master's Dissertation from the postgraduate Program in Integrative Medicine at the Quantum University, Honolulu, HI, USA.

Circadian Rhythm Recovery Using the BrainTap headset

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Background
International airline pilots and flight attendants often cross multiple time zones within short periods, significantly disrupting their circadian rhythms. This constant cycle of travel and attempted recovery places a considerable strain on the body, often resulting in various sleep disturbances. The ability to adapt to different time zones and recover quickly is a key determinant of how well these individuals tolerate international routes.

Methods
This was an exploratory study using a within-subject, pre-post design that included pilots and flight attendants who voluntarily tracked their sleep over a three-month period using a structured sleep log. Participants recorded their bedtime, sleep duration, sleep quality, and subjective feelings upon waking and throughout the day, using a 1–10 rating scale. In months two and three, participants incorporated the use of the BrainTap headset—an audio-visual brainwave entrainment device—along with a library of approximately 60 audio recordings. These included music-only tracks, guided visualizations, and ambient nature sounds. The intervention was self-directed, with participants free to choose recordings based on personal preference.

Results
Of the initial 15 participants, six (four pilots and two flight attendants; four females and two males) completed the full protocol and provided usable data. Across 50 international trips, participants showed notable improvements in all measured outcomes when using the BrainTap headset. The most significant gains were observed on Day 2 of recovery, including a 29% improvement in sleep quality (Cohen's d = 0.831), a 26% increase in morning alertness (Cohen's d = 0.940), and a 20% increase in daytime well-being (Cohen's d = 0.849). On Day 1, average sleep duration increased by nearly two hours (from 6.58 to 8.48 hours; Cohen's d = 0.897). Results varied across individuals, with one participant reporting inconsistent patterns likely related to pre-existing insomnia.

Conclusion
Use of the BrainTap headset, combined with audio-guided relaxation and visualization, was associated with improved sleep quality, recovery, and well-being among international flight crew members following long-haul travel. While the small sample size limits generalizability, these preliminary findings support the potential of audio-visual entrainment tools as adjuncts for circadian rhythm recovery.

Figures

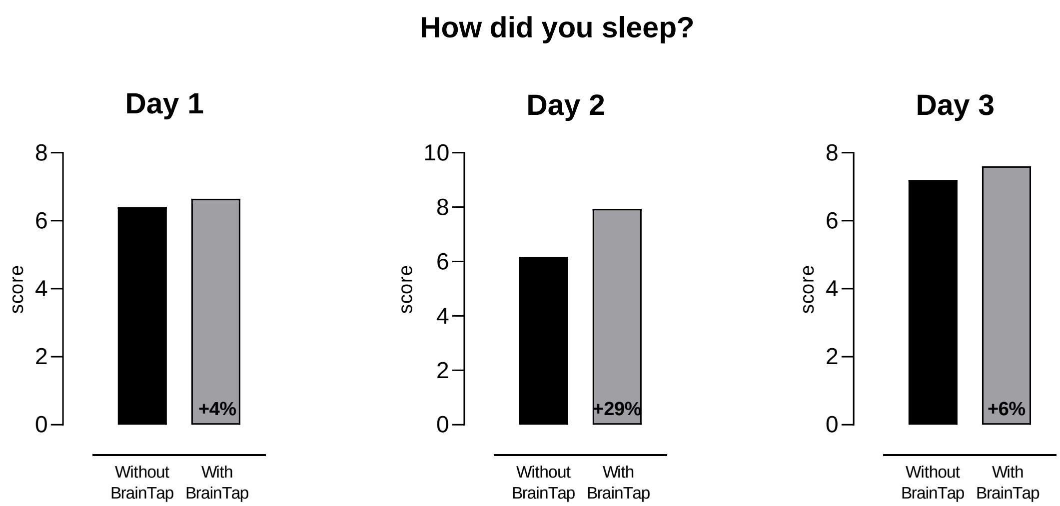

Figure 1. Self-reported sleep quality scores in response to the question “How did you sleep?” across three recovery days, with and without the use of the BrainTap headset.

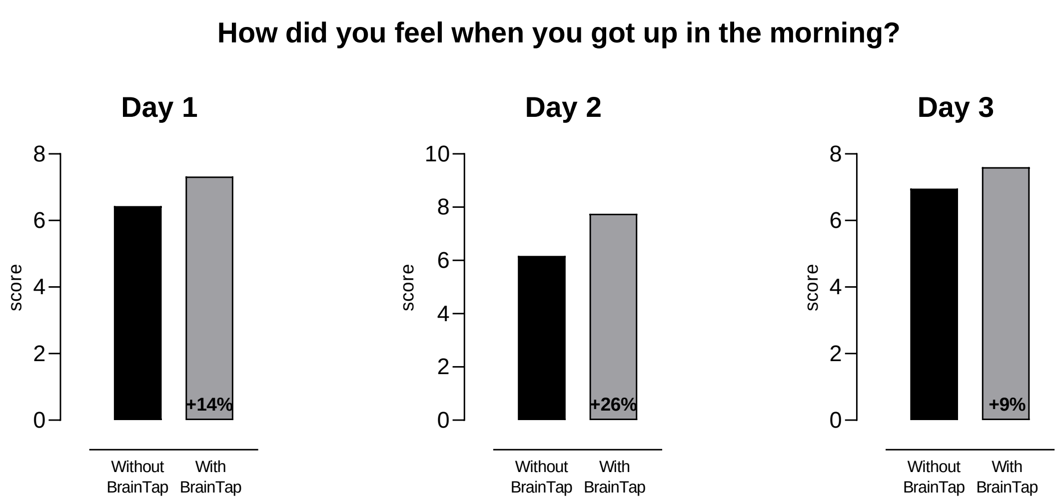

Figure 2. Self-reported sleep quality scores in response to the question “How did you feel when you got up in the morning?” across three recovery days, with and without the use of the BrainTap headset.

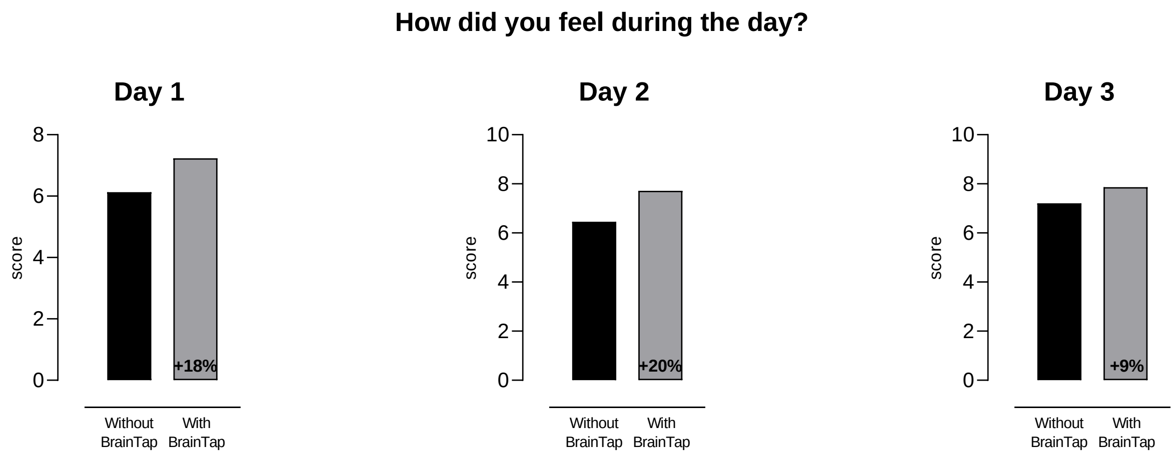

Figure 3. Self-reported sleep quality scores in response to the question "How did you feel during the day?" across three recovery days, with and without the use of the BrainTap headset.

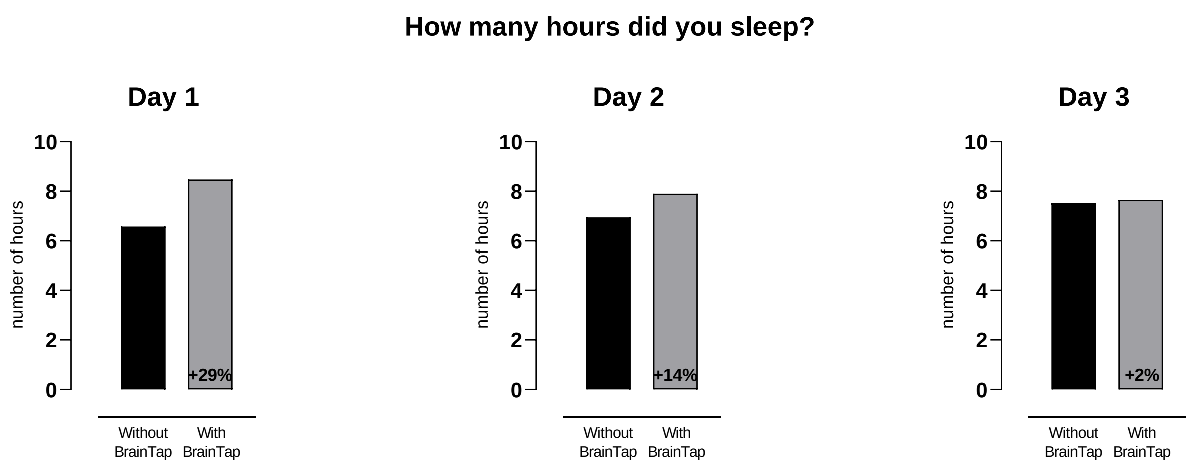

Figure 4. Self-reported hours of sleep in response to the question "How many hours did you sleep?" across three recovery days, with and without the use of the BrainTap headset.

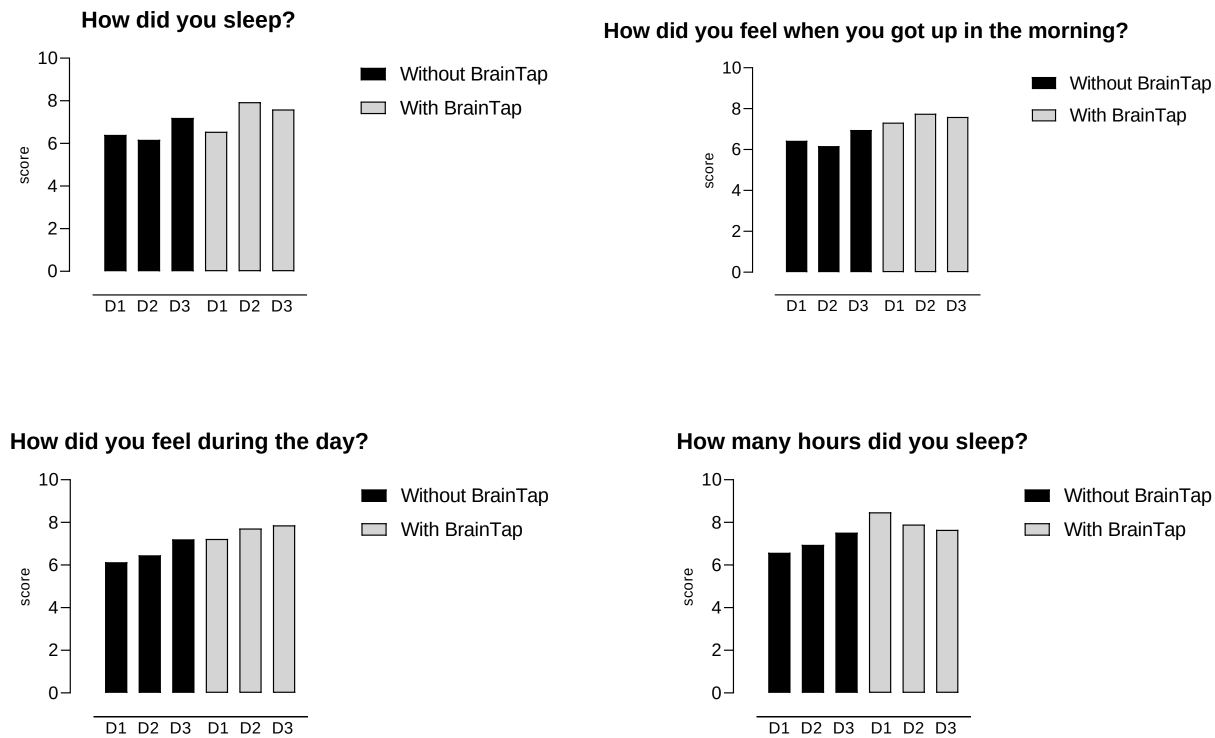

Figure 5. Self-reported outcomes across three recovery days (Day 1, Day 2, Day 3) with and without the use of the BrainTap headset.

Study #19 – Study conducted at the Sri Sri Neuro Centre, Warangal, Telangana, India.

Impact of Audiovisual Brainwave Entrainment on Alpha Wave Activity: A Real-Time EEG Assessment

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Objective
In this study, we aimed to investigate the impact of a 20-minute audiovisual brainwave entrainment session on alpha brainwave activity using continuous real-time electroencephalogram (EEG) monitoring.

Methods
The study was conducted at the Electrophysiology Laboratory of Sri Sri Neuro Centre in Warangal, Telangana. The research included 30 healthy participants aged 18 to 65 (male and female), with no neurological or psychiatric conditions. The BrainTap headset was used for audiovisual brain entrainment targeting alpha waves, and wave activity was measured before, during (EEG recording began 2 minutes after the beginning of the session), and after the session. The EEG electrodes were placed in the left side of the occipital region (O1), in the right occipital region (O2), and in the left frontal lobe (F3-C3) for readings of brainwaves' amplitude, frequency and power. The EEG data, recorded with a Nihon Kohden EEG machine, was preprocessed to ensure quality by removing artifacts and applying a notch filter. We used power spectral analysis and Density Spectral Array (DSA) to evaluate the power spectrum within a frequency band of 8 to 13 Hz over time. Statistical analysis, including ANOVA or Kruskal-Wallis followed by multiple comparisons tests, was conducted to compare alpha wave activity across the three phases.

Results
In the present study, when analyzing the left side of the O1 region, a significant increase in alpha amplitude was observed during ($p < 0.0001$) and after ($p < 0.0001$) the session, with large effect sizes (1.52 and 1.73, respectively). A significant increase in alpha power

was also observed during ($p < 0.0001$) and after ($p < 0.0001$) the session, again with large effect sizes (1.72 and 1.91, respectively). When analyzing the right side of the O2 region, a significant increase in alpha power during ($p < 0.0001$) and after ($p < 0.0005$) the session, also with large effect sizes (0.97 and 0.86, respectively). In analyzing the left side of the frontal region (F3-C3), no statistically significant differences were observed during and after the sessions. However, increases were noted in amplitude (17% between Before vs. During and 18% between Before vs. After), in frequency (1% and 2%, respectively), and in power (23% in both comparisons).

Conclusions

The findings of this study demonstrate that a 20-minute session of audiovisual brainwave entrainment significantly increases alpha brainwave activity in healthy adults. Both alpha amplitude and alpha power showed substantial increases during and after the session, as evidenced by highly significant p-values and large effect sizes. These results suggest that audiovisual brainwave entrainment is an effective method for enhancing alpha brainwave activity, which may have implications for relaxation, mental clarity, and overall cognitive function.

Figures

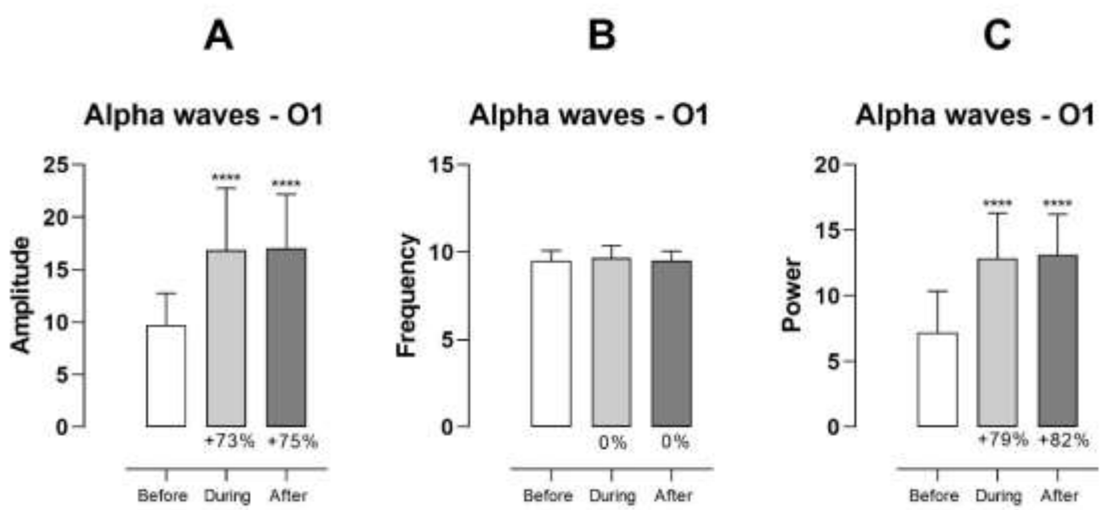

Figure 1. EEG assessment of alpha waves before, during, and after a 20-minute brainwave stimulation session in the O1 region. The data was analyzed by One-way ANOVA or Kruskal-Wallis test when appropriate. The value for significant statistical difference was set at <0.05. * Represents the significant statistical difference from baseline.

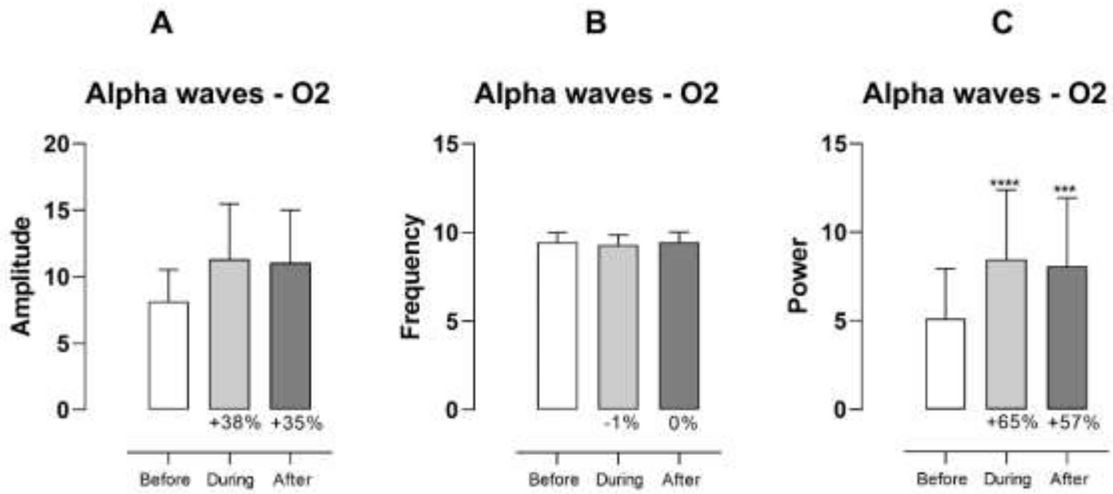

Figure 2. EEG assessment of alpha waves before, during, and after a 20-minute brainwave stimulation session in the O2 region. The data was analyzed by One-way ANOVA or Kruskal-Wallis test when appropriate. The value for significant statistical difference was set at <0.05. * Represents the significant statistical difference from baseline.

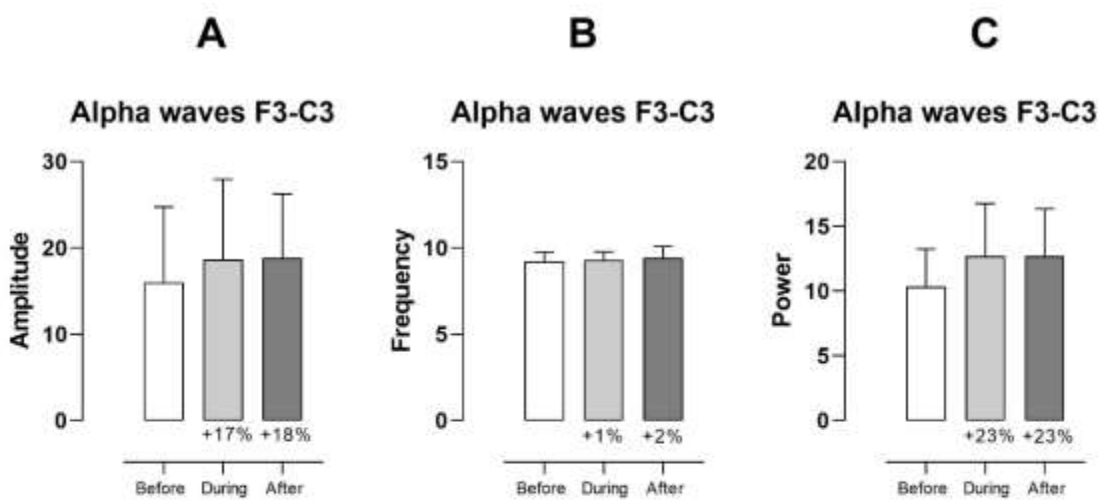

Figure 3. EEG assessment of alpha waves before, during, and after a 20-minute brainwave stimulation session in the F3-C3 region. Data were analyzed using one-way ANOVA or the Kruskal-Wallis test, when appropriate.

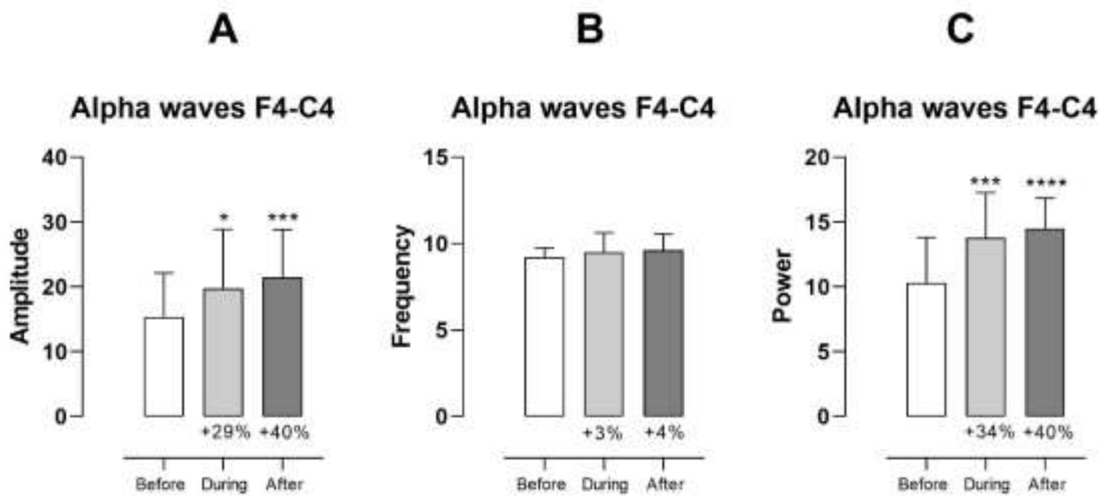

Figure 4. EEG assessment of alpha waves before, during, and after a 20-minute brainwave stimulation session in the F4-C4 region. The data was analyzed by One-way ANOVA or Kruskal-Wallis test when appropriate. The value for significant statistical difference was set at <0.05. * Represents the significant statistical difference from baseline.

Study #20 – Study conducted at the All India Institute of Medical Sciences (AIIMS), Bhopal, India. Published at Cadernos de Naturololgia e Terapias Complementares, Volume 12, number 21, 2023.

Effect of Brainwave Entrainment on Brainwave Frequency Spectrum and Heart Rate Variability

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Introduction

Brainwave entrainment (BWE) is a method that uses external stimuli, such as sounds, lights, or vibrations at specific frequencies, to guide the brain into specific brainwave patterns and states
of consciousness. BWE has gained importance in reducing stress, anxiety and restoring sleep. The aim of this study was to evaluate the effect of BWE on Heart rate variability (HRV) and Brainwave Frequency Spectrum (BFS).

Material and methods

Audio-visual BWE sessions were conducted (n=20) using an BWE device and cell phone application (the BrainTap® headset and app). The sessions entailed background music, guided slow deep breathing (SDB), and audio BWE through binaural beats and isochronic tones oscillating from 18 to 0. 5 Hz, as well as visual entrainment through light-emitting diode lights at 470 nanometers (nm) flickering at 18 to 0. 5 Hz. HRV and BFS were measured before and during the BWE sessions. BFS was assessed by an advanced neuro-fractal analysis.

Results

BWE sessions triggered a state of heightened focus (indicated by increased gamma and beta activity), as well as participants remaining alert and relaxed (marked by increased alpha waves). The study also recorded an increase in the Low Frequency (LF) power of HRV.

Conclusion

This finding suggests that these changes may be vagally mediated. Also, guided SDB might temporarily modulate HRV and act as a physiological method to tap into the cardio-vagal reserve. This study implies that BWE has potential benefits for cardiovascular autonomic regulation.

Figures

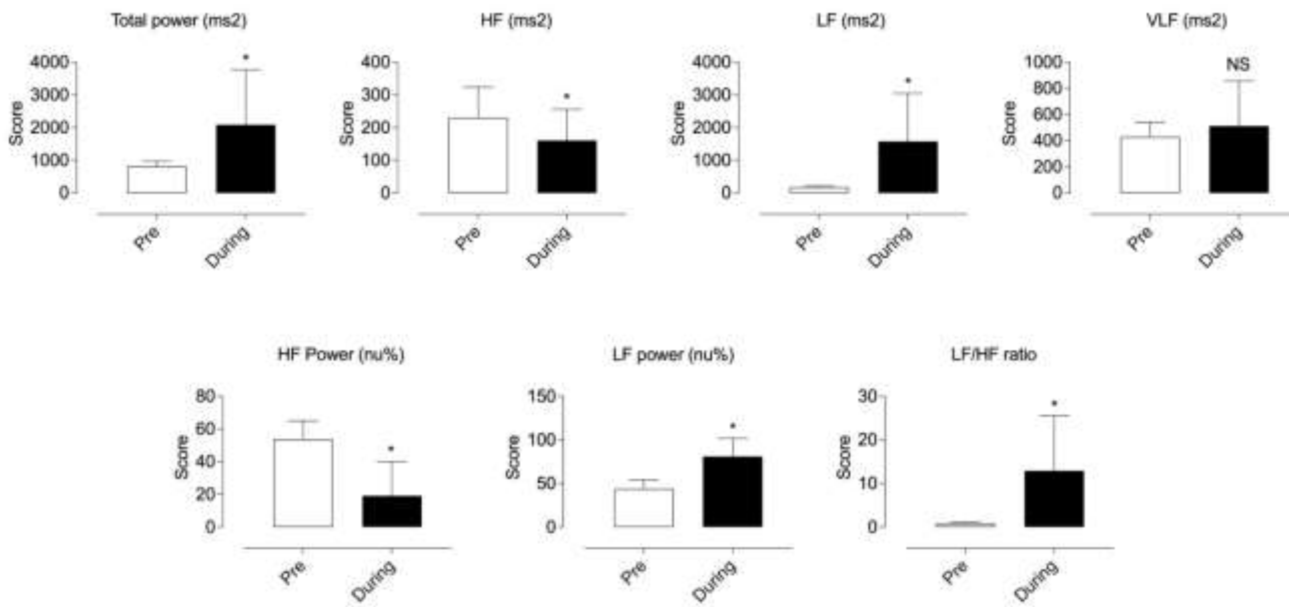

Figure 1 - Frequency results for HRV. Audio BWE session was effective in changing HRV parameters

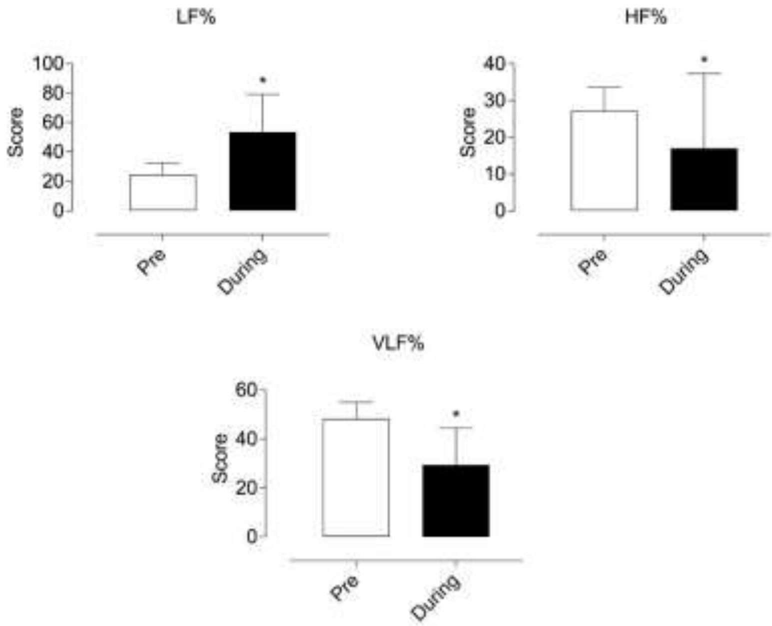

Figure 2 - Power results for HRV. Audio BWE session was effective in changing HRV parameters.

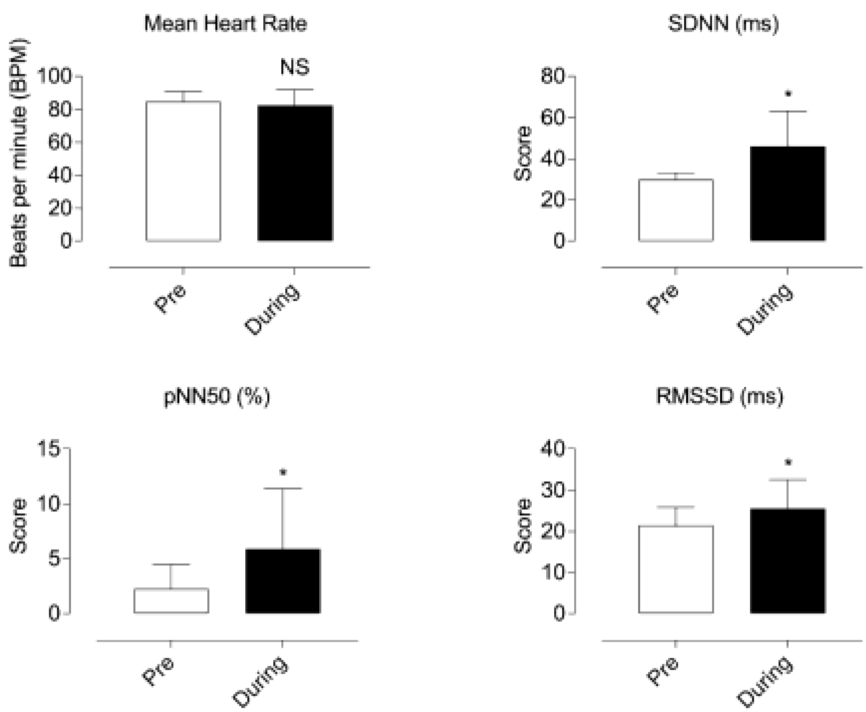

Figure 3 - Time domain HRV parameters. Audio BWE session was effective in changing HRV parameters.

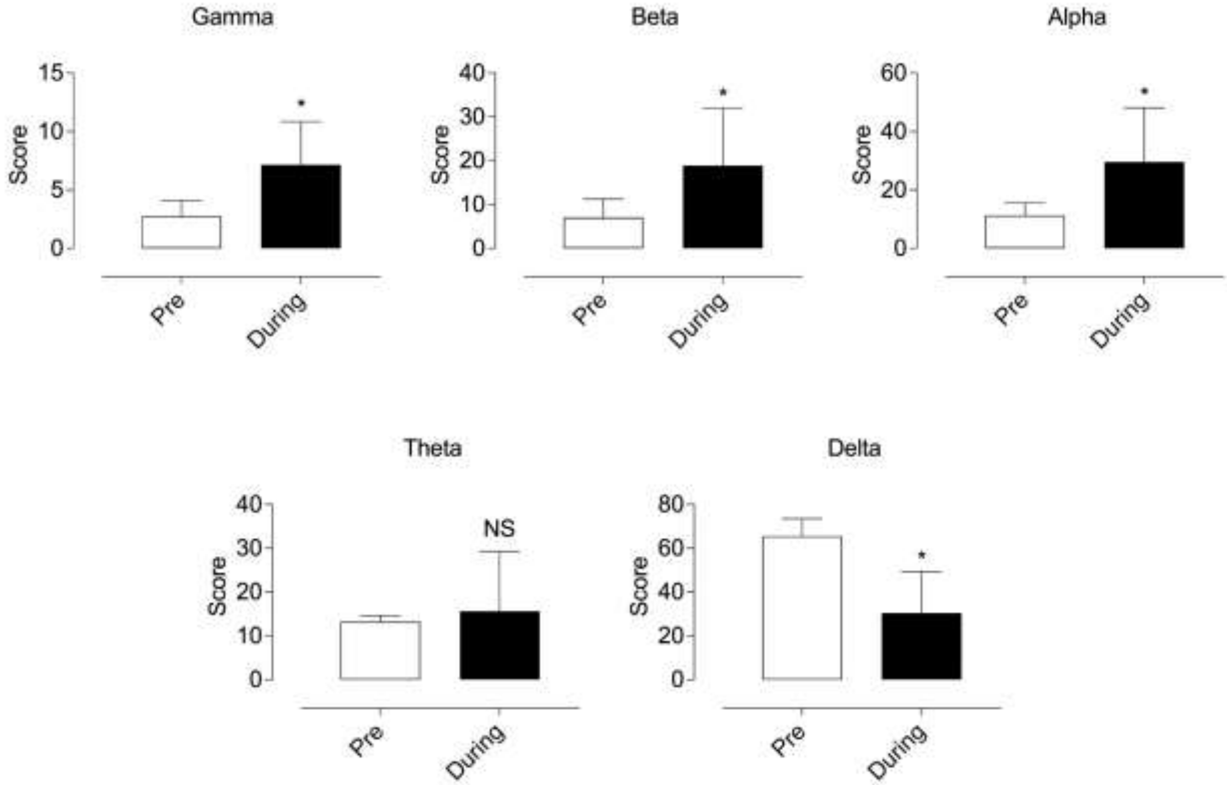

Figure 4 - Brainwave Frequency Spectrum. Audio BWE session affected brainwave frequencies.

Study #21 – Study conducted at the Seminole State College, Florida, USA.

Effects of BrainTap With and Without Vibrational Chair on Autonomic Regulation and Perceived Well-being: A Pilot Crossover Study

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Background
Audiovisual brainwave entrainment (BWE) is increasingly explored for its impact on autonomic regulation and subjective wellness. This pilot crossover study aimed to compare the effects of BrainTap alone and BrainTap combined with a vibrational chair on heart rate variability (HRV) parameters and perceived states of relaxation, mental clarity, and well-being.

Methods
Fifteen participants underwent two intervention conditions—BrainTap only and BrainTap combined with a vibrational chair—in a crossover design. Each session included structured HRV recordings before and after the intervention, alongside self-reported assessments of relaxation, mood, clarity, tension, and well-being. HRV analysis included time-domain (e.g., HR, SDNN, RMSSD), frequency-domain (LF, HF, LF/HF ratio, TP), and geometric indices (SI, HRV Index). Data were analyzed using parametric or non-parametric tests based on normality, with p-values < 0.05 considered statistically significant.

Results
The BrainTap-only condition produced statistically significant improvements across multiple HRV markers, including reductions in heart rate ($p = 0.0005$) and stress index ($p = 0.0107$), and increases in SDNN ($p = 0.0206$), RMSSD ($p = 0.0295$), and total power ($p = 0.0413$). LF and HF in normalized units also increased (both $p = 0.0479$) as well as LF/HF ratio ($p = 0.0168$). Subjective reports revealed statistically significant increases in relaxation (BrainTap + Chair: p= <0.0001; BrainTap: p= 0.0004), mental clarity (BrainTap + Chair: p= 0.0006; BrainTap: p= 0.0003), mood (BrainTap + Chair: p= 0.0015; BrainTap: p= 0.0252), well-being (BrainTap + Chair: p= 0.0017; BrainTap: p= 0.0424), and reductions in physical tension (BrainTap + Chair: p= <0.0001; BrainTap: p= 0.0067) in both conditions.

Conclusion

This pilot study suggests that BrainTap use—especially as a standalone intervention—can enhance autonomic balance, promote parasympathetic activity, and improve perceived well-being. The addition of vibration may further amplify subjective relaxation.

Figures

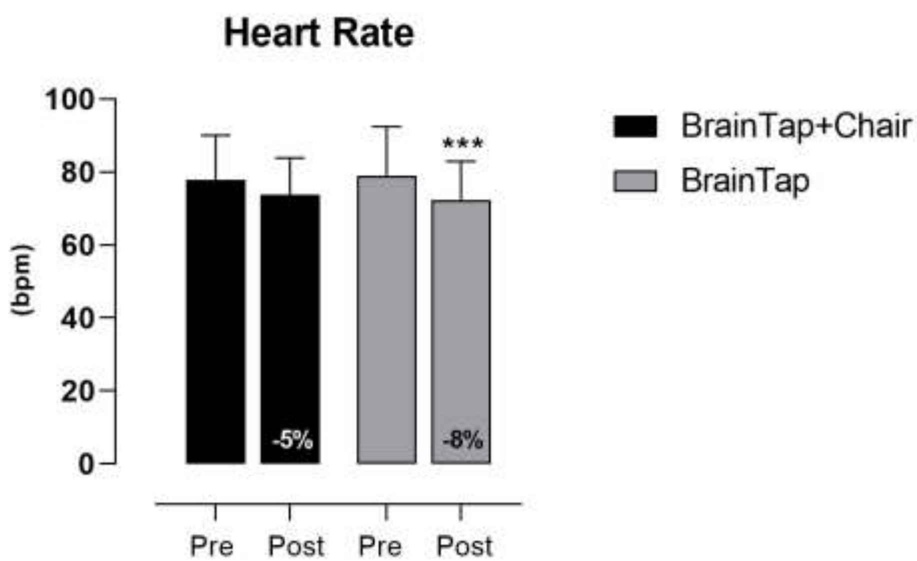

Figure 1. Heart Rate Parameter. The BrainTap only group presented a statistically significant reduction post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The data passed the Shapiro Wilk normality Test, and a paired T Test was performed.

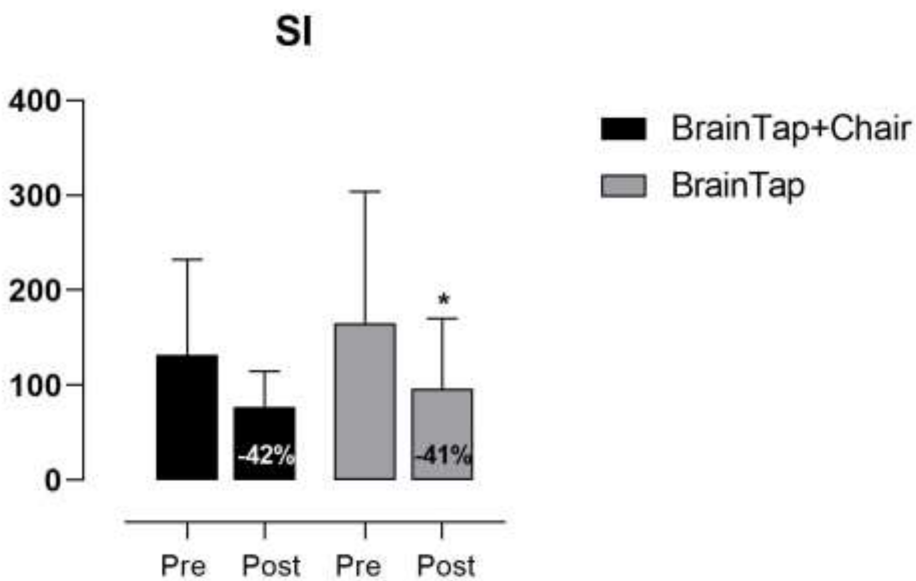

Figure 2. Stress Index parameter. The BrainTap only group presented a statistically significant reduction. Each point represents the mean of participants and vertical lines show the SD. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test and a Wilcoxon Test was performed.

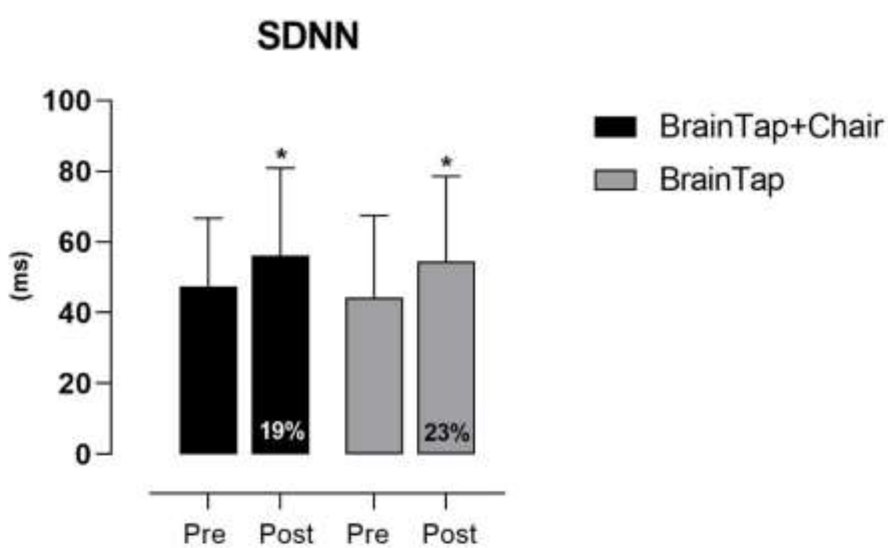

Figure 3. SDNN (ms) Parameter. Both groups presented statistically significant increases post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. BrainTap + Chair data did not pass the Shapiro Wilk normality Test, and a Wilcoxon Test was performed. BrainTap data passed the Shapiro Wilk normality Test, and a paired T Test was performed.

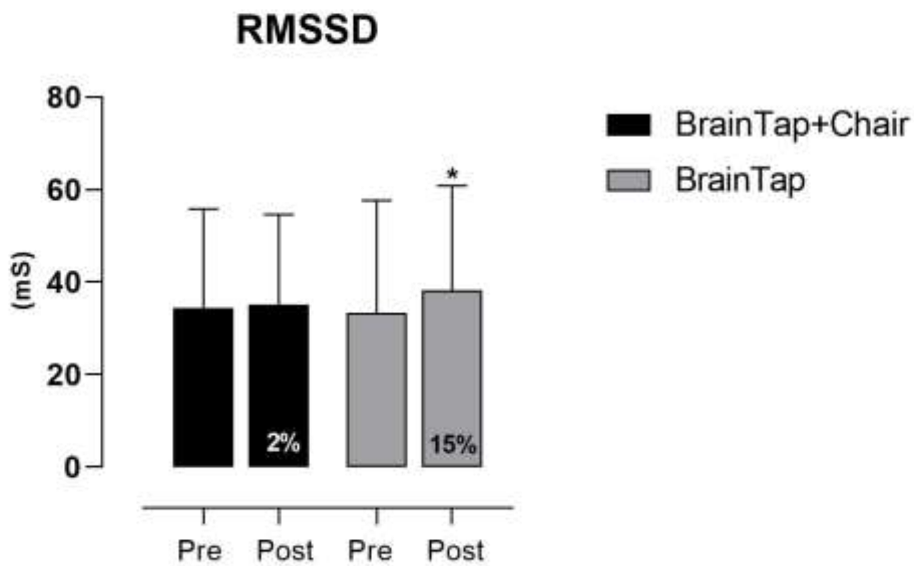

Figure 4. RMSSD (ms) Parameter. The BrainTap only group presented a statistically significant increase. Each point represents the mean of participants and vertical lines show the SD. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Wilcoxon Test was performed.

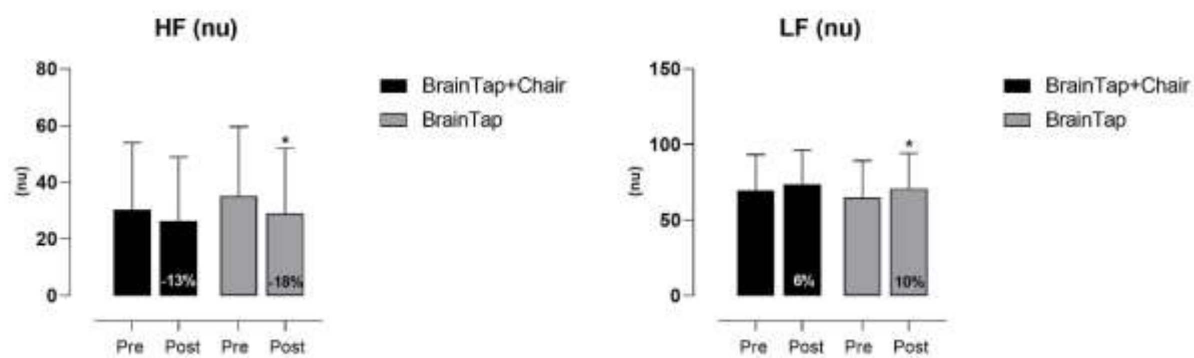

Figure 5. HF, LF Parameters in normal units. The BrainTap only group presented statistically significant differences. Each point represents the mean of participants and vertical lines show the SD. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Wilcoxon Test was performed.

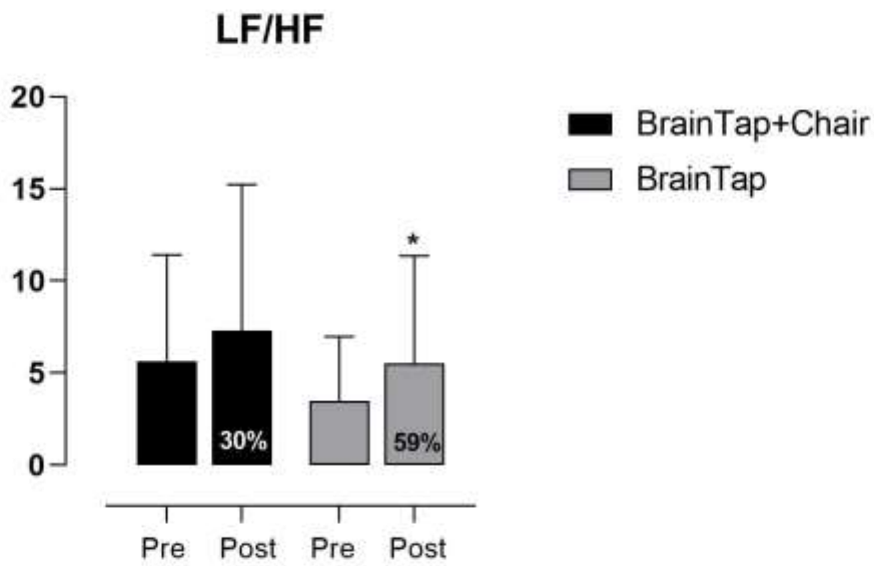

Figure 6. LF/HF Parameter. The BrainTap only group presented a statistically significant increase. Each point represents the mean of participants and vertical lines show the SD. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Wilcoxon Test was performed.

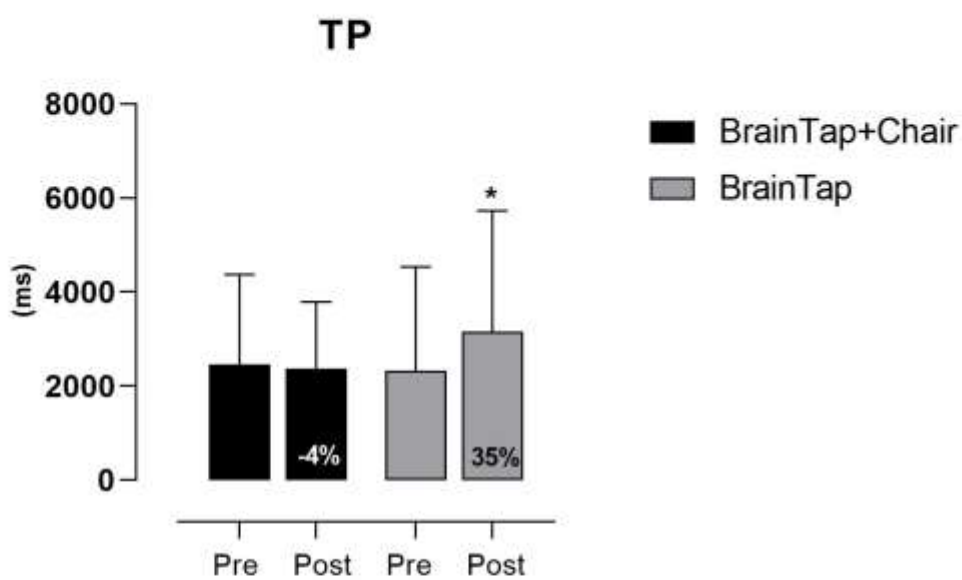

Figure 7. Total Power Parameter. The BrainTap only group presented a statistically significant increase. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Wilcoxon Test was performed.

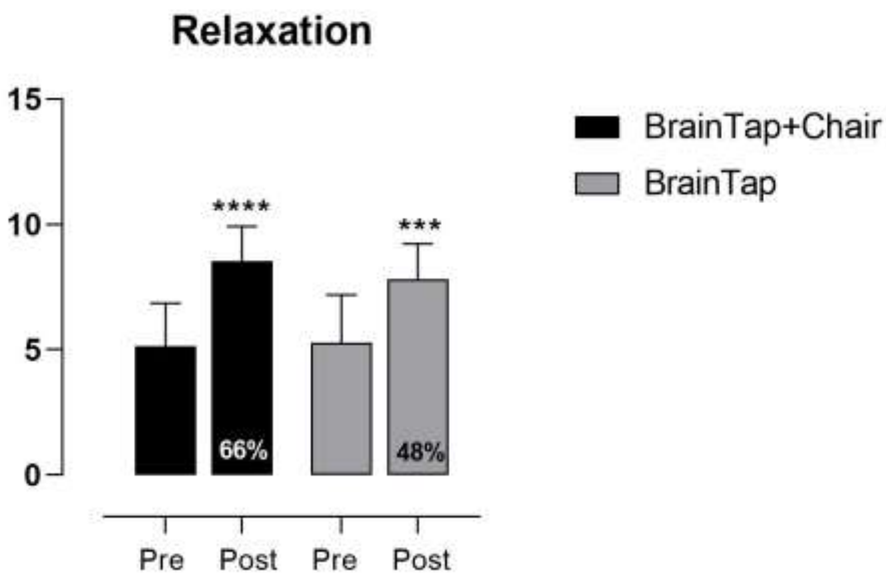

Figure 8. Relaxation. Both groups presented a statistically significant increase post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The BrainTap + Chair data did not pass the Shapiro Wilk normality Test, and a Mann-Whitney Test was performed. The BrainTap data passed the Shapiro Wilk normality Test, and an unpaired T-Test was performed.

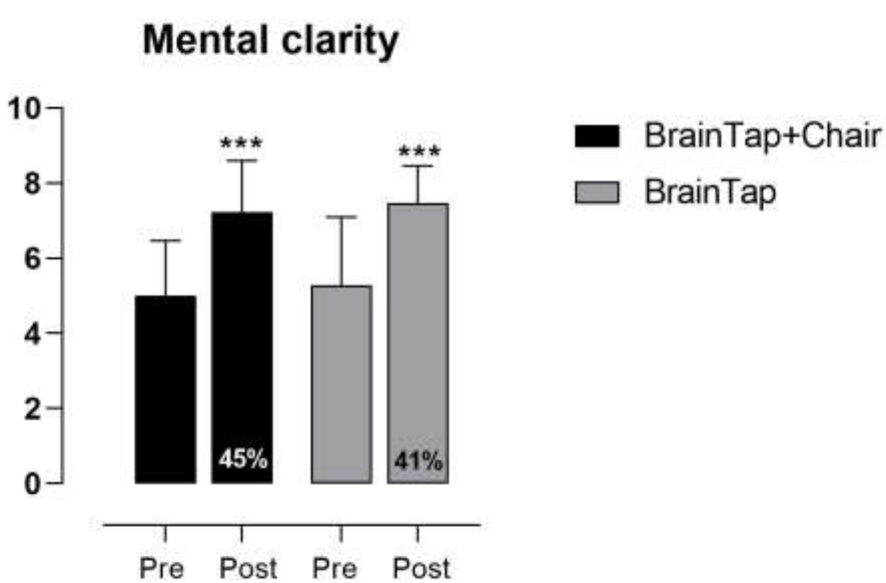

Figure 9. Mental clarity. Both groups presented a statistically significant increase post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant

difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Mann-Whitney Test was performed.

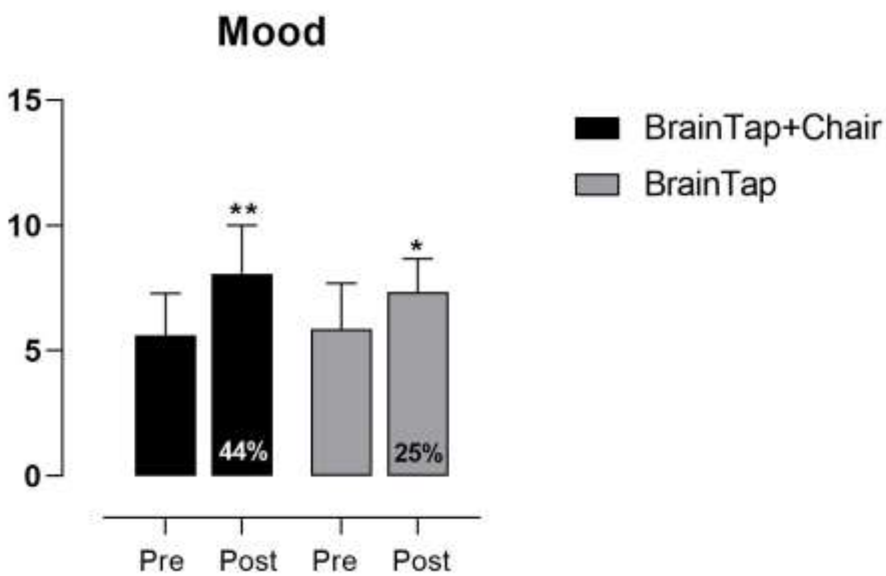

Figure 10. Mood. Both groups presented a statistically significant increase post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The data did not pass the Shapiro Wilk normality Test, and a Mann-Whitney Test was performed.

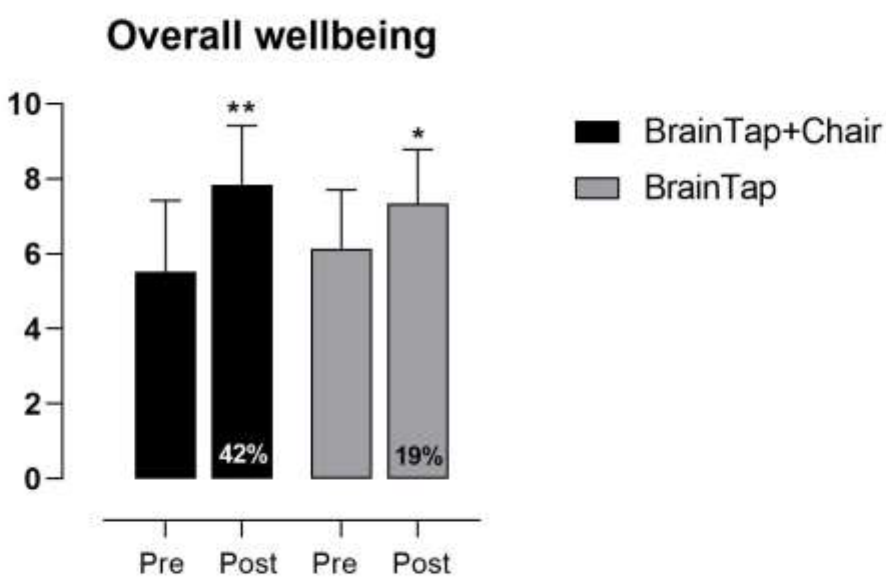

Figure 11. Overall wellbeing. Both groups presented a statistically significant increase post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The data passed the Shapiro Wilk normality Test, and an unpaired T Test was performed.

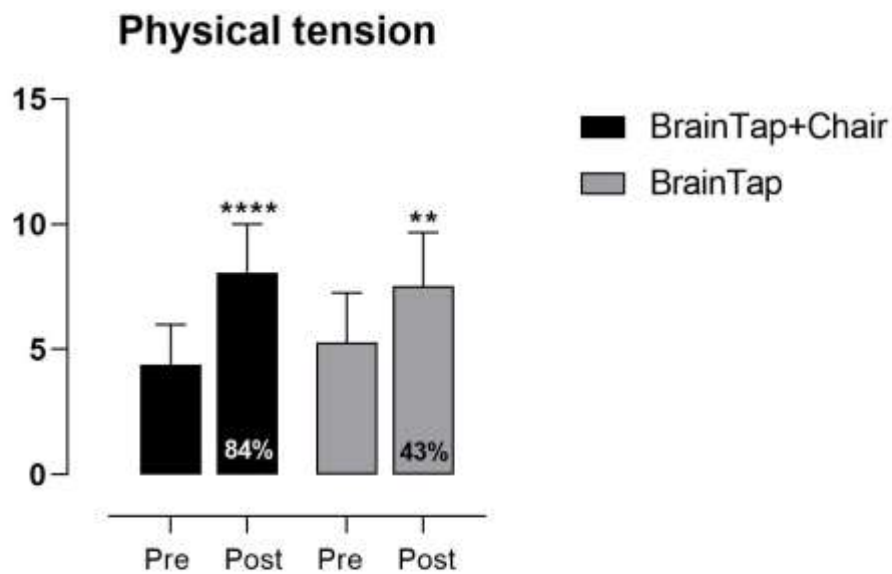

Figure 12. Physical Tension. Both groups presented a statistically significant increase post intervention. Each point represents the mean of participants and vertical lines show the SD. The Symbol * denotes a significant difference of *P<0.05 when compared to Pre evaluation. The % value is in relation to Pre evaluation. The BrainTap + Chair data did not pass the Shapiro Wilk normality Test, and a Mann-Whitney Test was performed. The BrainTap data passed the Shapiro Wilk normality Test, and an unpaired T-Test was performed.

Study #22 - Conducted with Special Forces Soldiers.

Effects of BrainTap Brainwave Entrainment on Stress and Sleep in Special Forces Soldiers: A Pilot Study

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4. The Soldier Fund, Jackson, Mississipi, United States of America

Background
Special forces soldiers face intense physical and mental demands that can impact stress levels, sleep, and cognitive function. Brainwave entrainment technologies like BrainTap may offer a non-invasive way to support recovery and resilience. This study explored BrainTap's effects in this high-performance population.

Methods
This pilot study evaluated the effects of a 3-week BrainTap brainwave stimulation program on psychological and physiological wellness indicators in 22 active-duty and former special forces soldiers. The intervention consisted of daily 20-minute sessions, with three in-person headset sessions per week and remaining sessions completed at home using the BrainTap app. Participants completed validated assessments—including DASS-21, PSQI, Mental Fatigue Scale, and the Stress Resilience Scale—at baseline and post-intervention. Physiological data were collected via PPG (Biotekna, Italy) and HEG (Biotekna, Italy) devices at baseline (prior to the first intervention) and at the conclusion of the intervention (end of the third week). Additionally, HRV measurements were performed at baseline, midpoint, and the end of the intervention using the Neuralchek device.

Results
Statistically significant improvements were observed in stress levels (DASS-21 Stress subscale, $p = 0.0229$; Cohen's $d = 0.59$) and overall sleep quality (PSQI Total Score, $p = 0.0347$; Cohen's $d = 0.64$), both with medium effect sizes. Additional trends, though not statistically significant, included reduced depressive symptoms (-49%), anxiety (-21%), and mental fatigue (-11%), as well as improved cerebral oxygenation (+37%) and bilateral blood flow gain (+13%). Component-level analysis of PSQI revealed improvements in most subdomains, although sleep medication use increased. Although most HRV changes were not statistically significant, the intervention was associated with increased parasympathetic activity, elevated VLF power, and reduced sympathetic activity—suggesting improved autonomic balance, relaxation, and emotional regulation. A decline

in HRV metrics post-intervention indicates that ongoing sessions may be needed to maintain these effects.

Conclusion

These findings suggest that BrainTap may offer stress-reduction and sleep-support benefits for special forces soldiers.

Figures

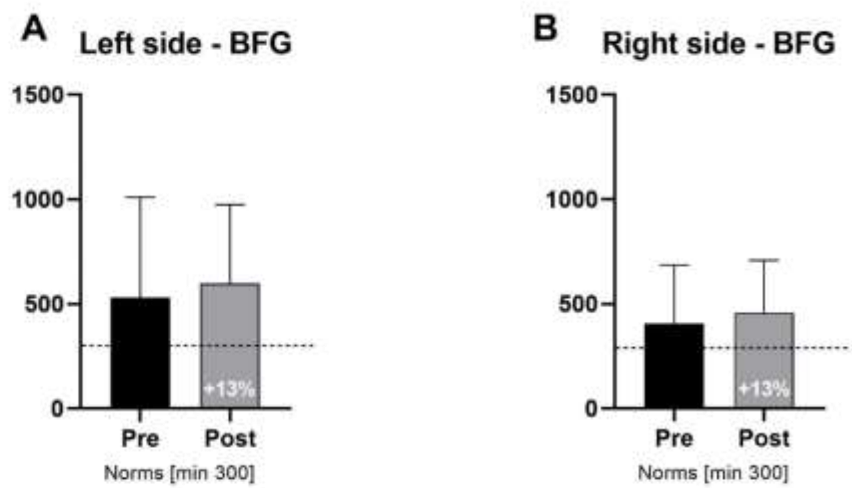

Figure 1 - BFG parameter**.** For comparisons between pre and post values, the Mann-Whitney test was used for L-BFG, and the unpaired t test was used for R-BFG. The value of statistical significance was set at <0.05.

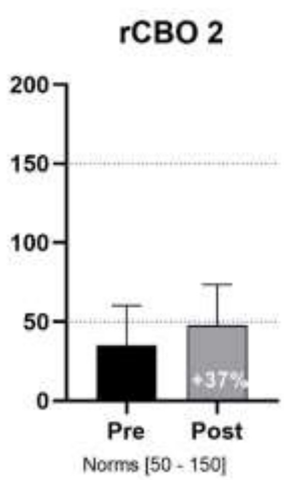

Figure 2 - rCBO2. For comparisons between pre and post values, the Mann-Whitney test was used. The value of statistical significance was set at <0.05.

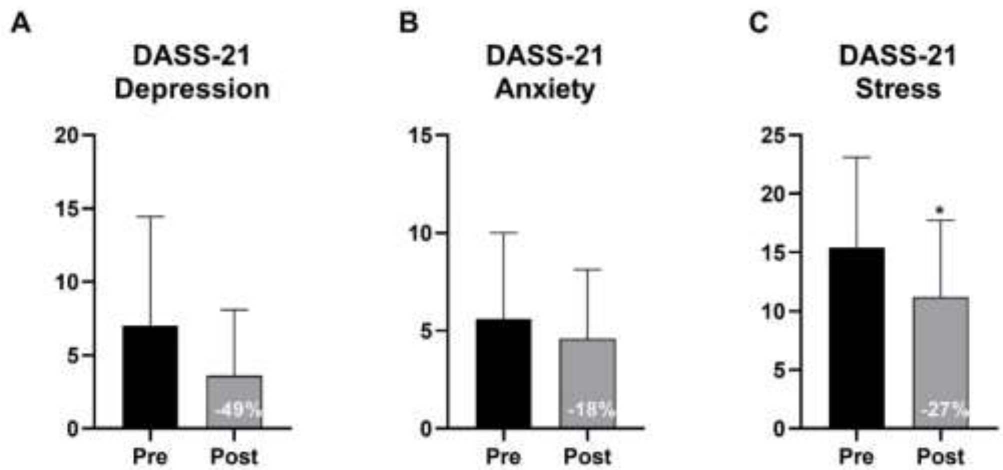

Figure 3 - DASS 21 – Depression, DASS 21 – Anxiety, and DASS 21 – Stress**.** For comparisons between pre- and post-values, the Wilcoxon test was used for DASS 21 – Depression, and the paired t-test was used for DASS 21 – Anxiety and DASS 21 – Stress. The statistical significance threshold was set at $p < 0.05$. * Denotes a statistically significant difference between baseline and post.

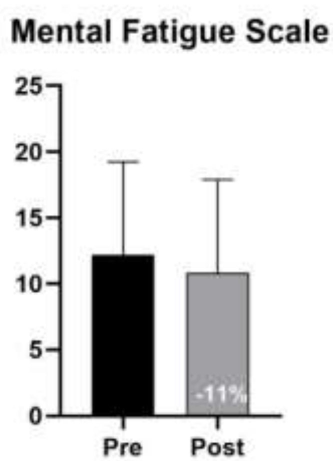

Figure 4 - Mental Fatigue Scale. For comparisons between pre- and post-values, the paired t-test was used. The statistical significance threshold was set at $p < 0.05$.

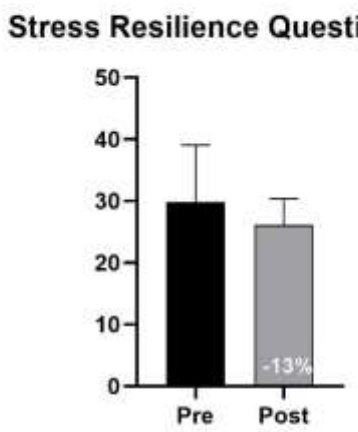

Figure 5 - Stress Resilience Scale. For comparisons between pre- and post-values, the Wilcoxon test was used. The statistical significance threshold was set at $p < 0.05$.

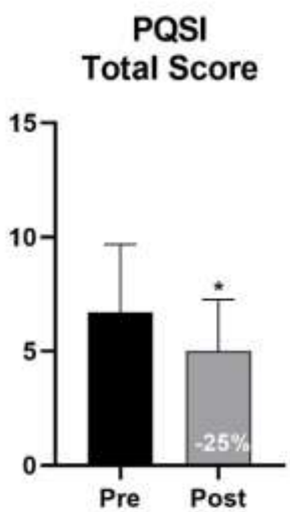

Figure 6 - PSQI total score**.** For comparisons between pre- and post-values, the paired t-test was used. The statistical significance threshold was set at $p < 0.05$. * Denotes a statistically significant difference between baseline and post.

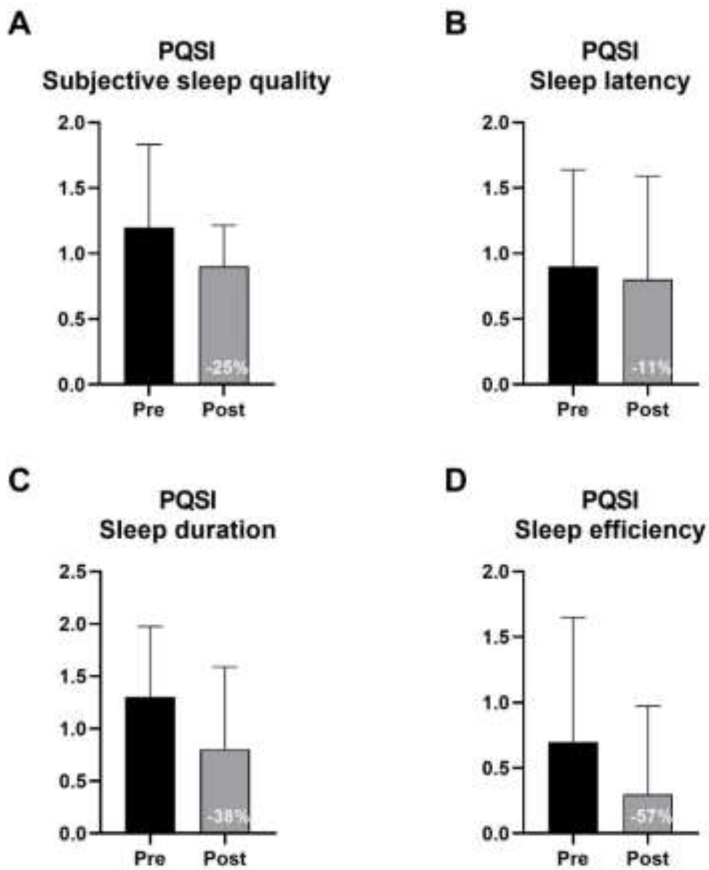

Figure 7 - PSQI Subjective sleep quality, Sleep latency, Sleep duration, and Sleep efficiency. For comparisons between pre- and post-values, the Wilcoxon test was used. The statistical significance threshold was set at $p < 0.05$.

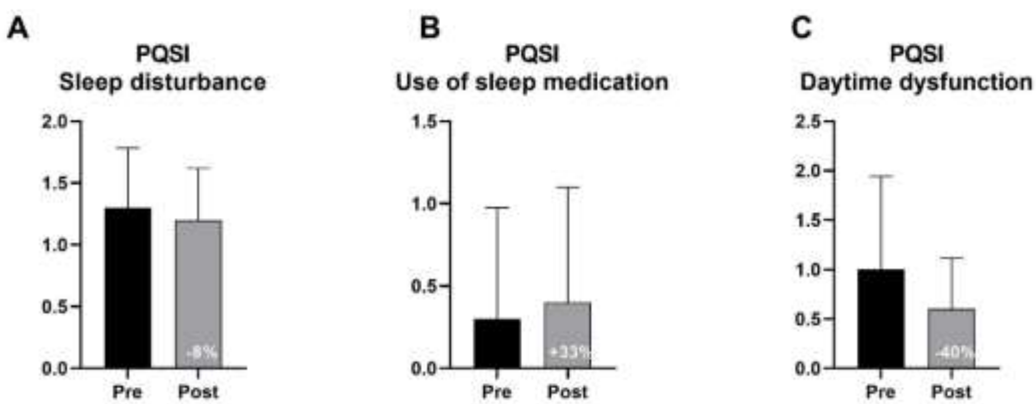

Figure 8 - PSQI Sleep disturbance, Use of sleep medication, and Daytime dysfunction. For comparisons between pre- and post-values, the Wilcoxon test was used. The statistical significance threshold was set at $p < 0.05$.

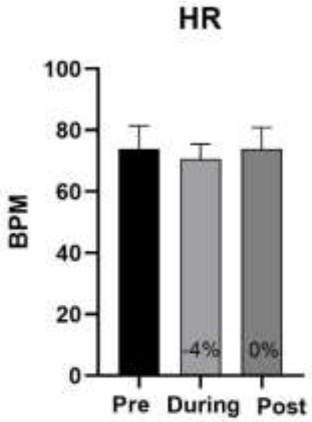

Figure 9 - Heart Rate. Ordinary one-way ANOVA was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

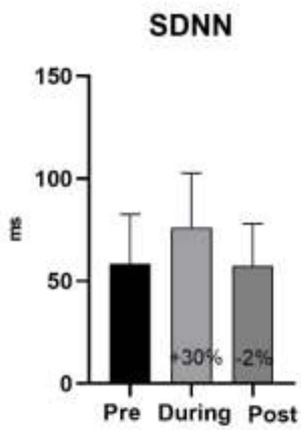

Figure 10 - SDNN**.** Ordinary one-way ANOVA was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

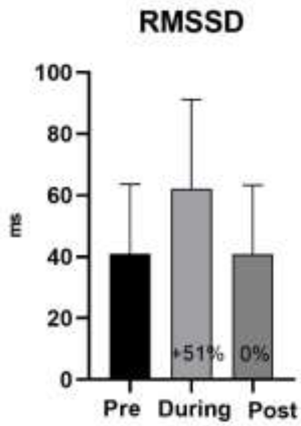

Figure 11 - RMSSD. Kruskal-Wallis test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

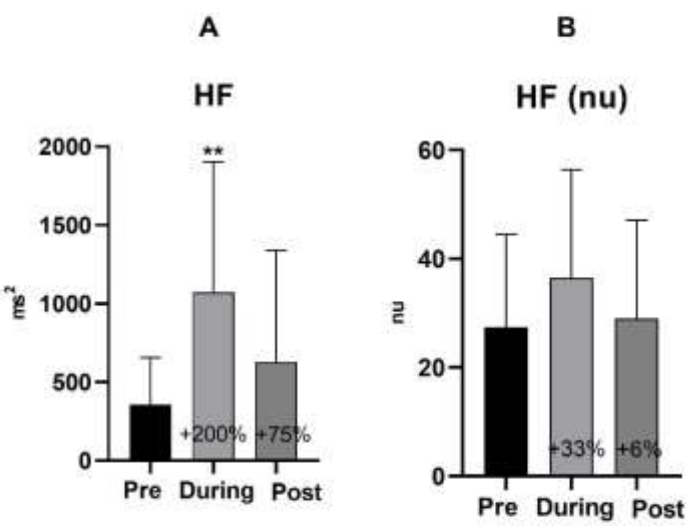

Figure 12 - Hf and Hf (nu). Kruskal-Wallis test followed by Dunn's multiple comparisons test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$. * indicates statistical significance compared to baseline.

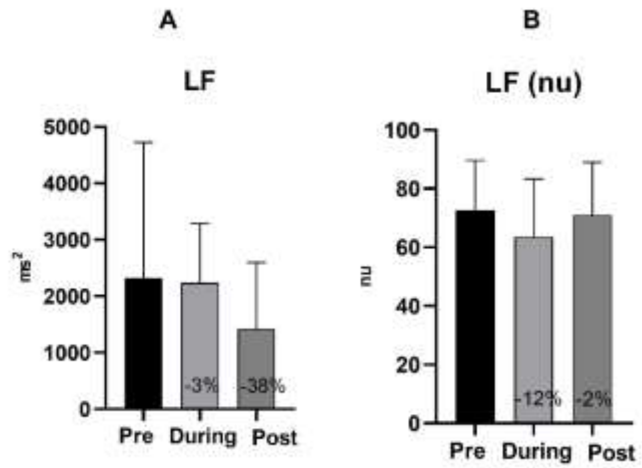

Figure 13 - Lf and Lf (nu). Kruskal-Wallis test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

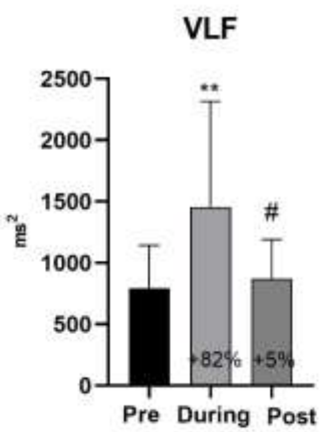

Figure 14 - VLF. Ordinary one-way ANOVA followed by Tukey's multiple comparisons test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$. * in relation to baseline, # in relation to midway.

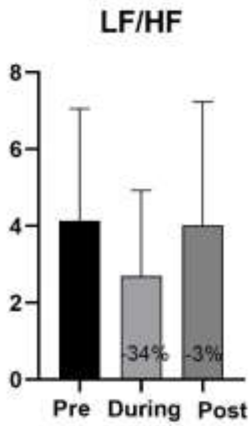

Figure 15 - LF/HF**.** Kruskal-Wallis test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

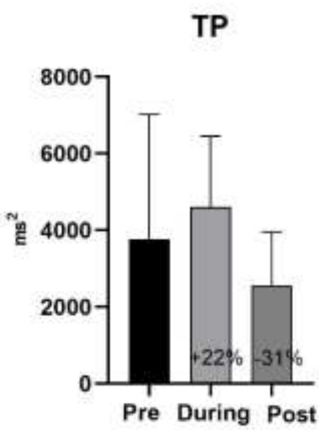

Figure 16 - TP. Kruskal-Wallis test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

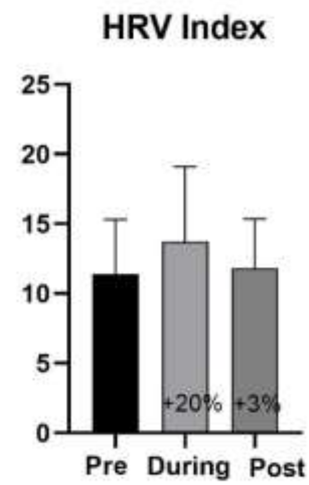

Figure 17 - HRV Index**.** Kruskal-Wallis test was used for comparisons between pre- and post-values. The threshold for statistical significance was set at $p < 0.05$.

Study #23 – Conducted at the Seminole State College, Florida, USA. Published at the Revista Mexicana de Neurociência. 2025;26(1):5-13. doi: 10.24875/RMN.24000024

The effects of auditory brainwave entrainment on the psychophysical health of healthcare programs students

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Objective
This pilot study aimed to explore the modulatory potential of auditory Brainwave Entrainment (aBWE) on the emotional and physical well-being of college students enrolled in healthcare programs.

Methods
All enrolled participants from the Seminole State College received the same intervention of daily aBWE sessions over a 12-week period. Evaluations were conducted at the outset (1st week), midpoint (6th week), and conclusion (12th week), utilizing four distinct questionnaires: the Pittsburgh quality of sleep index (PQSI), the perceived stress scale (PSS), the generalized anxiety disorder 7 (GAD-7), and the profile of mood States (POMS).

Results
Twenty-nine participants (mean age of 39.41) completed the study. In the PQSI, reductions were observed in Subjective Sleep Quality ($p = 0.0039$), Sleep Latency ($p = 0.0454$), and the Global Score ($p = 0.0175$). The PSS indicated significant reductions in stress after 6 weeks ($p = 0.0402$) and 12 weeks ($p = 0.0006$). The GAD-7 scale revealed a significant reduction in anxiety by the final evaluation ($p < 0.0001$). Similarly, the POMS questionnaire showed significant decreases in Tension at both midpoint ($p = 0.0259$) and final evaluations ($p = 0.0001$), along with reductions in Total Mood Disturbance (midpoint $p = 0.0485$, final $p < 0.0001$). In addition, significant improvements were noted in Depression ($p = 0.0314$), Anger ($p = 0.0454$), Vigor ($p = 0.0297$), Fatigue ($p = 0.0002$), and Confusion ($p = 0.0019$) by the final evaluation.

Conclusions

We conclude that aBWE presents a promising intervention for enhancing sleep quality, mood states, and reducing stress and anxiety, without any reported adverse effects, indicating its safety.

Figures

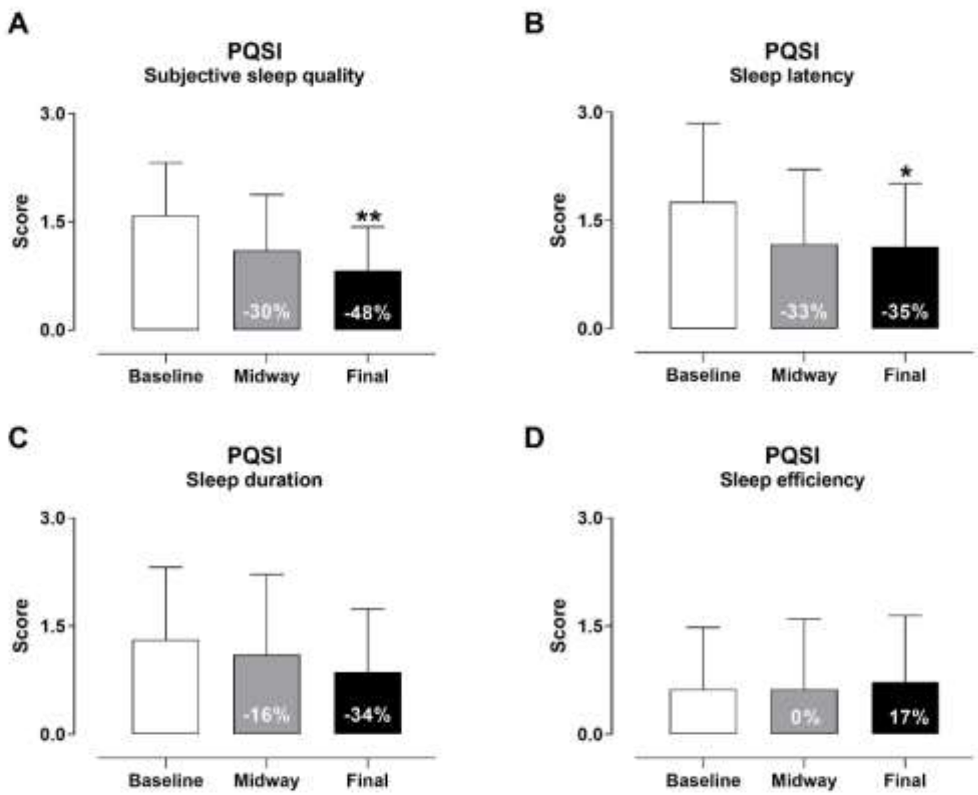

Figure 1 A-D - 12 weeks of Audio Brainwave Entrainment sessions significantly improved the Subjective sleep quality and Sleep latency components. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by Friedmans' test followed by Dunn's multiple comparison test. PQSI: Pittsburgh Quality of Sleep Index; SD: standard deviation.

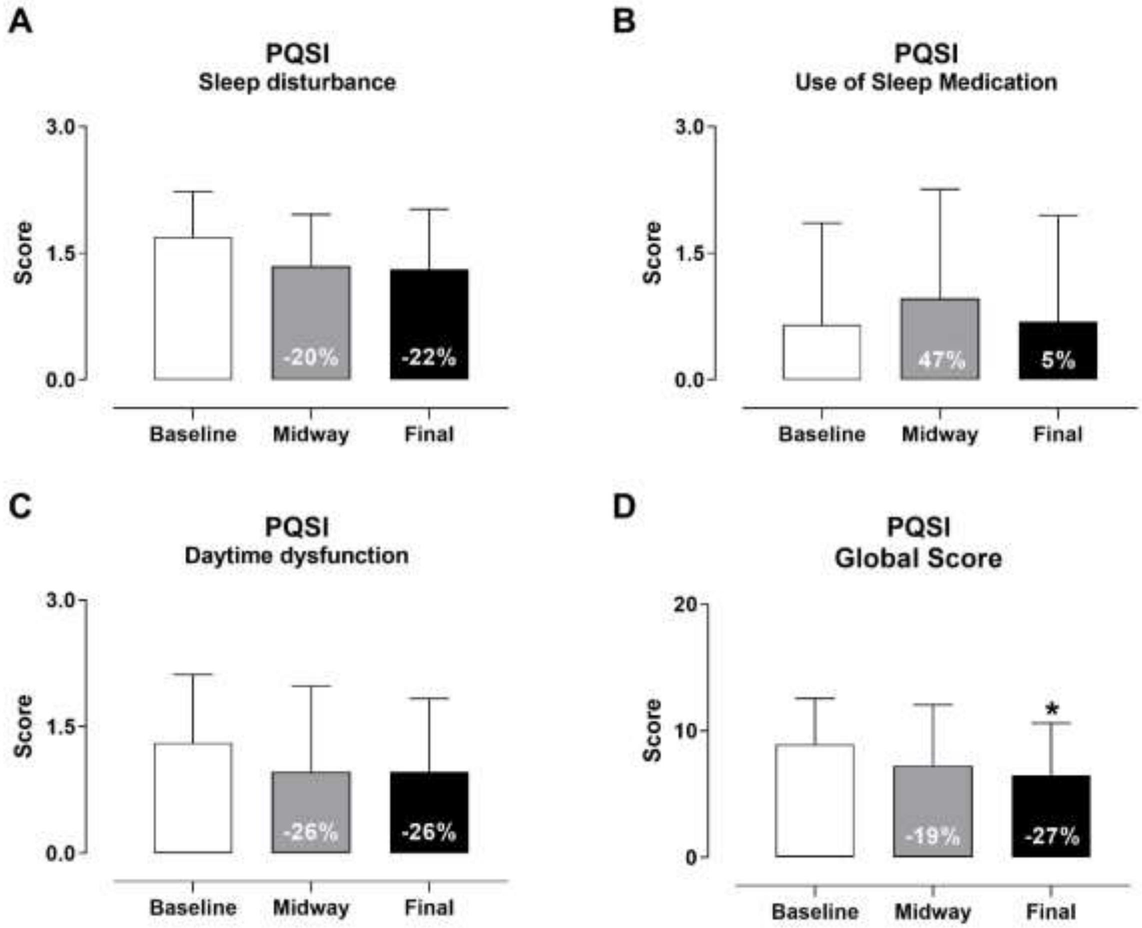

Figure 2. A-D - 12 weeks of Audio Brainwave Entrainment sessions significantly improved the PQSI Global Score. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by Friedmans' test followed by Dunn's multiple comparison test. PQSI: Pittsburgh Quality of Sleep Index; SD: standard deviation.

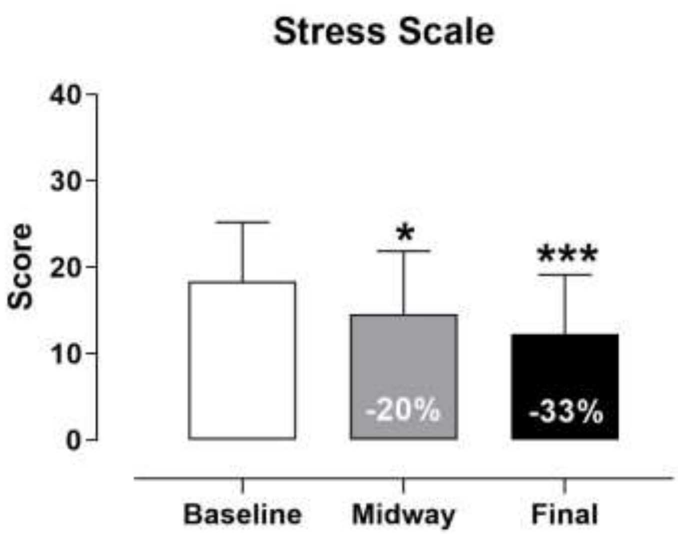

Figure 3 - After 6 and 12 weeks of Audio Brainwave Entrainment sessions participants had lower perceived stress. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by RM one-way analysis of variance followed by Tukey's multiple comparison test. RM: repeated measures; SD: standard deviation.

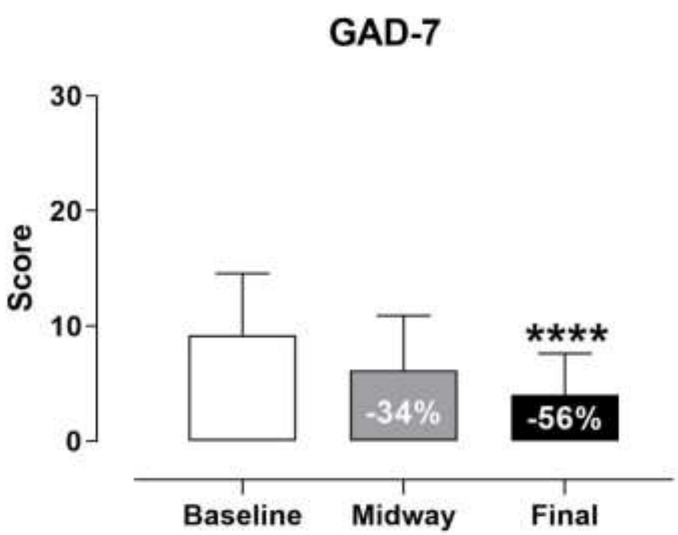

Figure 4 - 12 weeks of Audio Brainwave Entrainment sessions significantly reduced participant's anxiety. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by Friedmans' test followed by Dunn's multiple comparison test. SD: standard deviation.

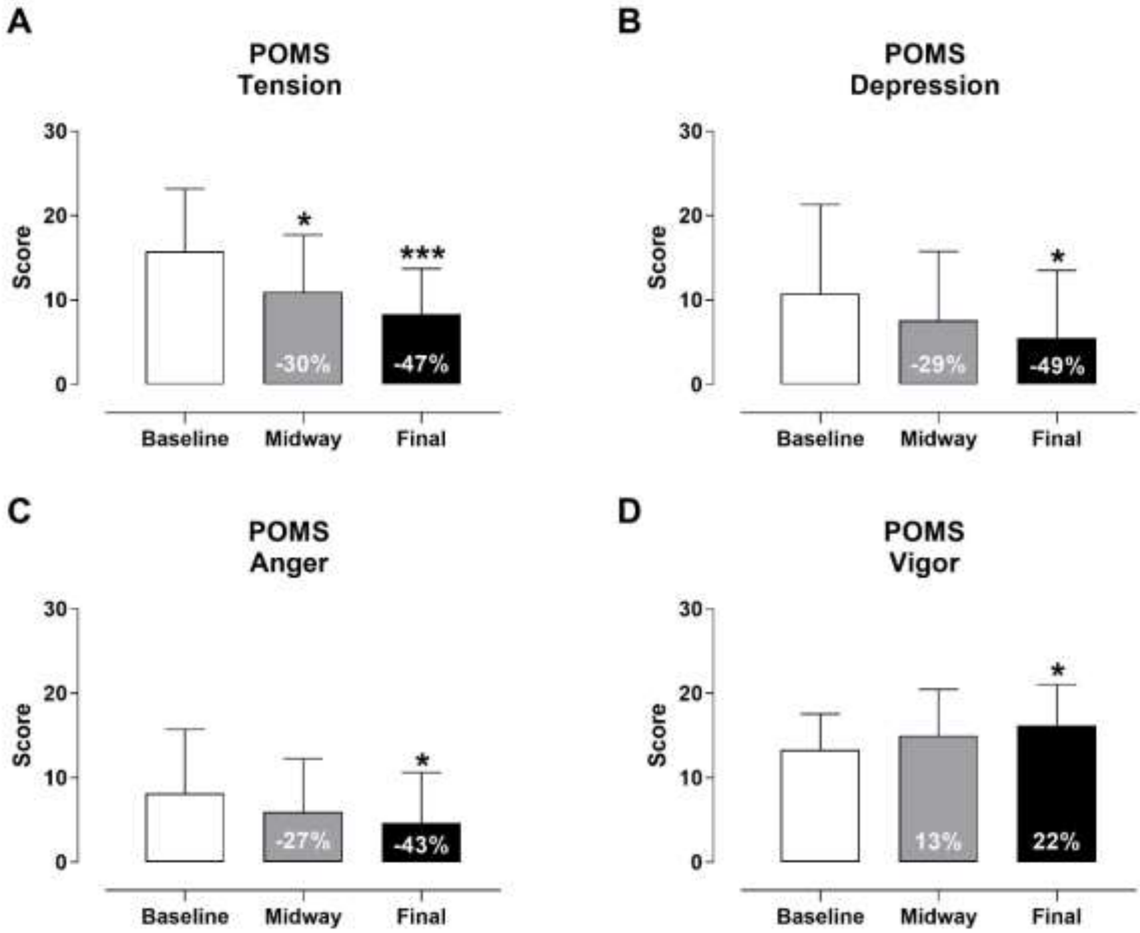

Figure 5. A-D - 6 and 12 weeks of Audio Brainwave Entrainment sessions significantly changes participants mood states. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by Friedmans' test followed by Dunn's multiple comparison test in sub-scales **A, B,** and **C**, and by RM one-way analysis of variance followed by Tukeys multiple comparison test in sub-scale **D.** POMS: Profile of Mood States; RM: repeated measures; SD: standard deviation.

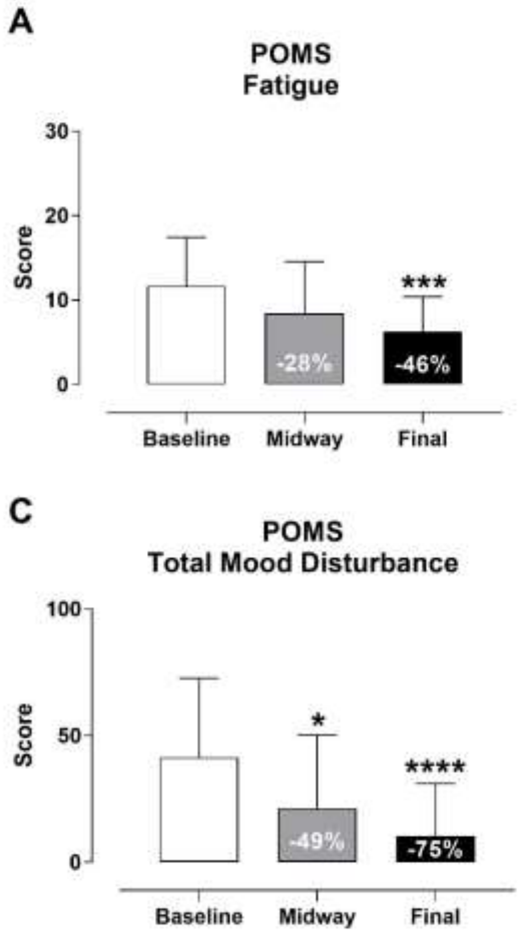

Figure 6. A-D - 6 and 12 weeks of Audio Brainwave Entrainment sessions significantly changes participants' mood states. Each point represents the mean of 29 participants and vertical lines show the mean with SD. *Significant difference of $p < 0.05$ when compared baseline evaluations. The % value is in relation to the baseline. Statistical analysis was performed by Friedmans' test followed by Dunn's multiple comparison test. POMS: Profile of Mood States; RM: repeated measures; SD: standard deviation.

Study #24 – Review study. Published at the Revista Mexicana de Neurociência. 2021;22():238-247. doi:10.24875/RMN.20000100

Effects of binaural beats and isochronic tones on brain wave modulation: Literature review

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2. Experimental Neuroscience Laboratory (LaNEx), University of Southern Santa Catarina (UNISUL), Palhoça, Santa Catarina;
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Background
This systematic review is dedicated to deepening the study of two phenomena: binaural beats and isochronic tones. Data from the scientific literature suggest the existence of a promising therapeutic potential in neurology and psychophysiology due to their influence on specific frequencies of brain waves and their implications for mental health and homeostasis of brain neurotransmitters. Prolonged audio stimuli in repetitive and synchronized manner may induce changes in brain waves patterns and, consequently, modulating neurophysiological, and behavioral responses.

Methods
The literature review was conducted using the online databases PUBMED, MEDLINE, LILACS, and SCIENCE DIRECT. The following search terms were used: “audio brain entrainment,” “auditory beat stimulation,” “binaural beats,” “brainwave entrainment (BWE),” and “isochronic tones.” . These studies were evaluated according to the Cochrane Handbook for Systematic Reviews and further assessed using the Jadad scale for methodological quality.

Results
The initial search yielded 674 studies. After removing 49 duplicates and excluding 592 studies that were out of scope, 33 randomized, controlled clinical trials remained. From that, 17 studies obtained a score of three points or more on the Jadad scale. These studies were fully read and critically analyzed. Binaural beats were used in 15 studies (88.25%), whereas isochronic tones were used only in two studies (11.76%). Although most of the studies reviewed here indicated audio BWE effectiveness, some positive outcomes may require further investigation, with more refined and appropriate evaluation tools, better suited for each specific type of intervention and/or therapeutic target. Considering these limitations, the performance of additional studies with more adequate experimental design and data analysis is recommended, particularly focusing on the neurophysiological and behavioral effects of brain wave entrainment on mental states.

Conclusion

Based on the data reviewed in this study, binaural beats and isochronic tones BWE may effectively modulate mood states, improving attention, and memory processes. Promising results were also obtained in subjects suffering from different CNS disorders, including ADHD, PD, epilepsy, chronic pain, and anxiety disorders.

Figures

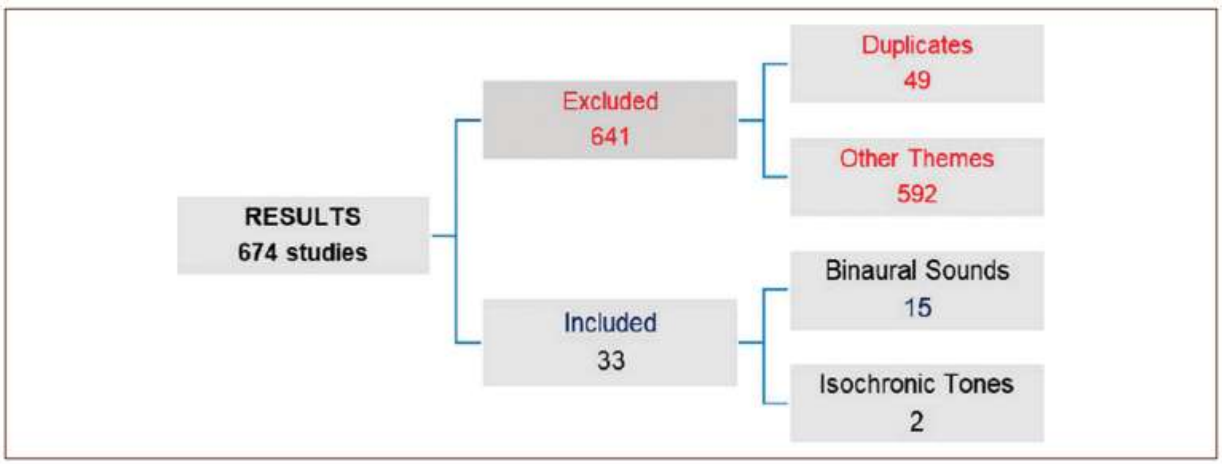

Figure 1- Randomization algorithm and study selection

Study #25 – Review study. Published at the Applied Psychophysiology and Biofeedback journal. 2025;50:3-9. doi:10.1007/s10484-024-09682-x

An Integrative Review of Brainwave Entrainment Benefits for Human Health

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Background
Brainwave Entrainment (BWE) is a noninvasive method of neuromodulation based on the principle that auditory or visual stimulation at a specific frequency can lead the brain's electrocortical activity to oscillate at the frequency of the external signal or its multiples. This phenomenon could be used to alter physiological and psychological states. Therefore, we conducted an integrative review to answer the question: "What are the observed benefits of BWE on human health and well-being?"

Methods
We searched for studies published in the last ten years in the Directory of Open Access Journals (DOAJ), EMBASE, Virtual Health Library (BVS), PubMed, SciELO, and Cochrane Library databases in April 2024. Searches were conducted in English, Portuguese, and Spanish.

Results
A total of 84 studies were included in our review. Studies showed improvements in various conditions, such as pain, sleep disturbances, mood disorders, cognition, and neurodegenerative disorders.

Conclusion
BWE demonstrates promising therapeutic potential and may support the management of various health conditions, enhancing individuals' quality of life.

Figures

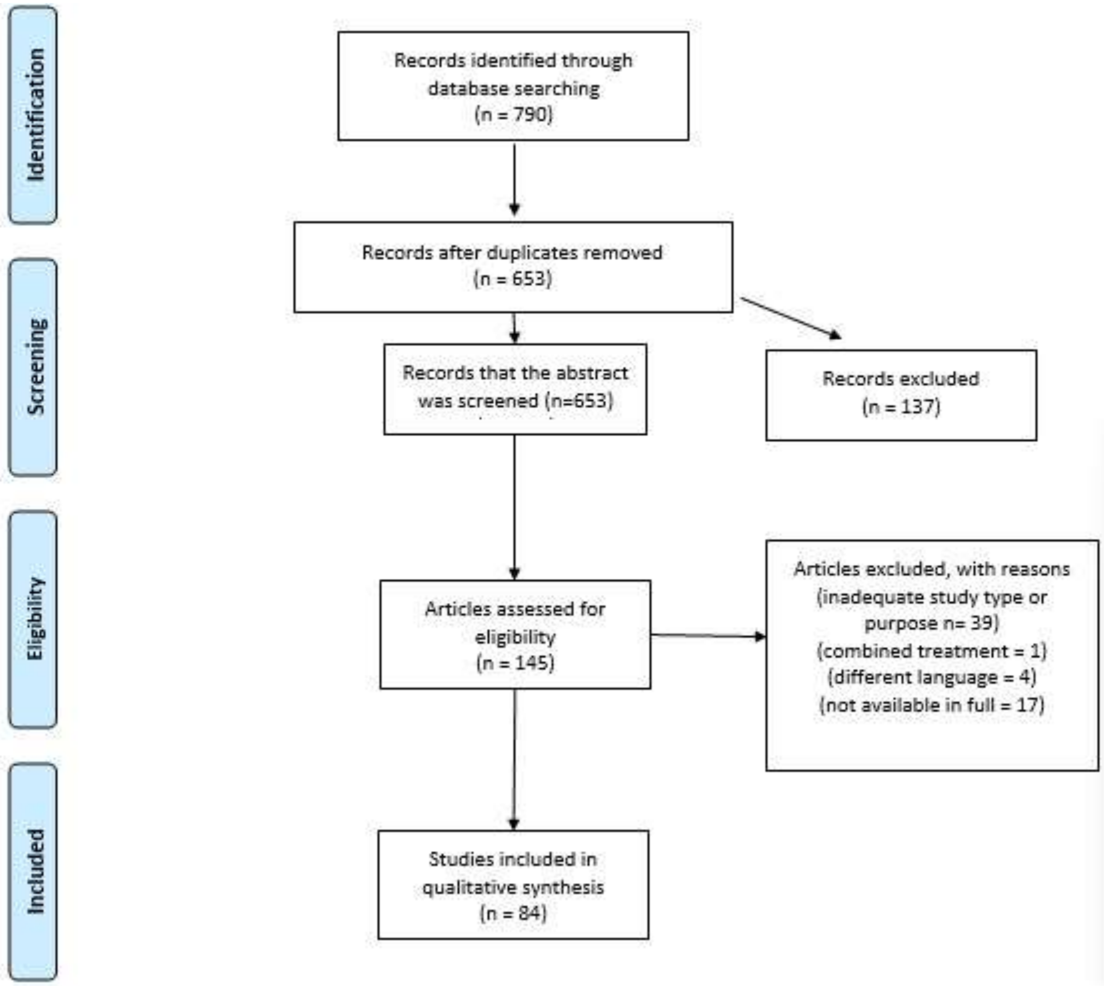

Figure 1 - Study flow diagram