Is Less More? A Self-Report and QEEG Look at Mindfulness-Based Interventions

Morrigan E. Holmes, Claudia Porras Pyland, Bahia Ramirez, Chelsey Charbeneau, Shon Mondragon, Thomas Guffey

INTRO

Mindfulness-based interventions (MBIs) foster present-moment awareness and acceptance and are linked to improvements in stress levels, sleep quality, and overall well-being[5–10]. However, much of the existing research relies solely on self-report measures, which limits our understanding of how MBIs affects both psychological and neurological outcomes. Additionally, there are still questions about the optimal "dose" of meditation[8].

We aimed to address these gaps by combining self-report data with electroencephalography (QEEG) to examine the effects of low-frequency (twice weekly) versus high-frequency (four times weekly) MBIs over a 12-week period. We assessed various outcomes, including sleep quality, anxiety, stress, well-being, attention, and vitality, along with neurophysiological measures. This randomized controlled trial will help clarify the dose-response relationship in MBIs.

METHODS

Design and Participants:

A 12-week randomized controlled trial included 87 adults (86.7% women). Eligible participants' age ranged from 25–60 (*M* = 38.5). Exclusion criteria: severe mental health or neurodegenerative conditions.

Groups and Interventions:

Random assignment:

(1) Control with no intervention.

(2) Low-frequency: 2/week, 30-min in-person sessions.

(3) High-frequency: 4/week, 30-min in-person sessions.

Participants chose their preferred MBI (e.g., focused attention, loving-kindness, sound bath).

Measures:

- Mindful Attention Awareness Scale (MAAS) for trait mindfulness[1].
- Fatigue Assessment Scale (FAS) for chronic fatigue symptoms[7].
- The World Health Organization-Five Well-Being Index (WHO-5) for overall well-being[9].
- Sleep Condition Indicator (SCI) for quality[4].
- QEEG at baseline and post-intervention to assess neurophysiological changes.

Procedure:

Data were collected pre-, mid-, and post-intervention. Participants completed surveys online and attended on-site QEEG sessions. Attrition was tracked, and missing data were addressed using appropriate imputation.

RESULTS

Repeated-measures ANOVAs tested the effect of MBI dose (2x/wk, 4x/wk, control) on mindfulness, fatigue, sleep, and well-being over time and by brain-wave activity level.

Because we lacked a commercial QEEG normative database, we followed Collura's (2014) guidance to derive z-scores from our own sample distribution. A meaningful change was set a priori as a shift ≥ 1 SD in two or more frequency bands (δ, θ, α, β, high-β) from pre- to post-intervention, mirroring the ±1–2 SD window routinely used in neurofeedback to flag clinically relevant activity[2]. Participants who met this criterion were labeled as *High-change*; all others were labeled as *Low-change*. Categorizing EEG change into Low vs. High responders also avoids the sphericity violations that would likely arise if brainwave bands were collapsed into a single repeated-measures factor.

Main Findings

Both 2- and 4-session conditions significantly improved mindfulness, sleep, and fatigue; the control group did not change significantly. Fatigue improvement was driven by Low-change QEEG participants; High-change did not reach significance (*p* =.154).

- **Time main effect:** all four outcomes improved ($p < .001$).
- **Dose effect:** 2× and 4× sessions out-performed control on:
  - Mindful attention, $F(2, 81)=8.09$, $p < .001$.
  - Sleep, $F(2, 81)=9.78$, $p < .001$.
  - Fatigue, $F(2, 81)=3.72$, $p =.029$.
- **QEEG:** large shifts not required to see improvement; High-change showed a modest extra sleep bump ($\eta^2 = .05$).

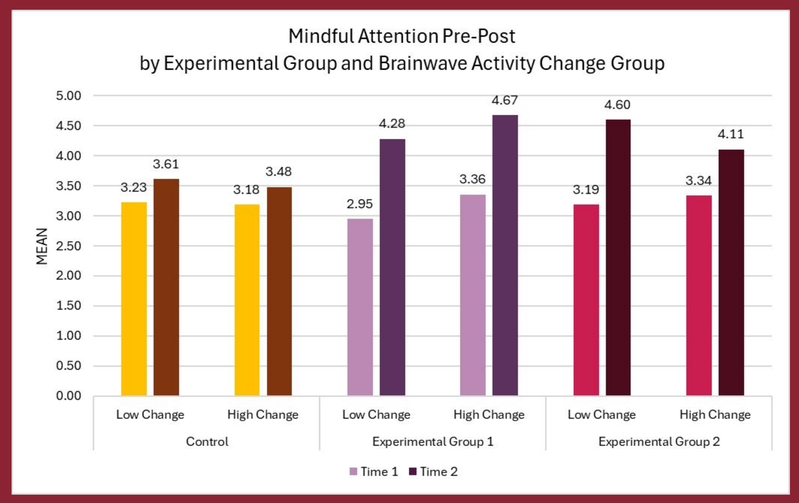
Pre-to-Post Change (Δ = Post − Pre) in Behavioral Outcomes by QEEG Change Level

Outcome	Low-change	High-change
Mindful Attention ↑	+1.37 pts (+45%) **	+1.04 pts (+31%) *
Sleep Quality ↑	+0.88 pts (+25%) **	+0.64 pts (+19%) **
Fatigue ↓	–0.66 pts (–23%) **	–0.44 pts (–18%)
Well-Being ↑	+0.54 pts (+15%) *	+0.38 pts (+10%) *

Note. **p < .001; *p < .01; Low-change = ≤ 1 SD shift in ≤ 1 brain-wave band; High-change = ≥ 1 SD shift in ≥ 2 bands. Positive Δ indicates improvement for all outcomes except Fatigue, where negative scores reflect improvement despite the negative sign.

Behavioral gains emerged in both QEEG sub-groups.

Figure 1. Pre-Post Changes in Mindful Attention by MBI Dose and Brain-Wave Response



Scan the QR code to explore interactive visualizations of all behavioral outcomes – including mindfulness, fatigue, sleep quality, and overall well-being – across study groups. →

DISCUSSION

Our findings demonstrated clear benefits of MBIs for mindfulness, fatigue, and sleep quality compared to a wait-list control group. Notably, even the lower meditation dose (twice weekly) produced significant improvements, suggesting that fewer weekly sessions may be a more efficient and practical approach. Additionally, behavioral improvements occurred regardless of the magnitude of brainwave (QEEG) shifts, although participants who experienced larger QEEG changes showed a modest additional improvement in sleep quality specifically. This suggests that even small neurophysiological shifts are generally sufficient to support meaningful self-reported benefits from MBIs, with potentially enhanced effects when larger brainwave changes occur.

However, these results should be interpreted cautiously due to methodological limitations. Primarily, there were challenges ensuring accuracy and consistency in the brainwave data. Although visual inspections suggested adequate quality, the lack of an experienced EEG technician limits certainty regarding QEEG measurements.

Future studies should replicate our findings in larger, more diverse samples to increase statistical power and generalizability. Employing ongoing EEG monitoring during meditation sessions would also strengthen confidence in interpreting neurophysiological effects. Ultimately, better understanding dose-response relationships through both behavioral and neurophysiological lenses will support the practical application of MBIs.

TABLES, FIGURES, & REFERENCES