Mind Full or Mindfulness! The Effectiveness of Mindfulness Using Brainwave Entrainment Portable EEG Muse™ S First Generation

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Abstract: A client had difficulty sleeping and was isolated at the start of the Covid-19 pandemic in 2020. Full attention to breath, body, and mind activities is essential in mindfulness practice. Treatments and measurements of mental relaxation are administered using the first-generation Muse™ "S" Series. Portable and the "Muse: Meditation and Sleep" by InteraXon apps, connected by mobile technology (iPad/ iOS). This research method uses a single-subject study design with a time series approach. The research sample was conducted on clients with post-stroke comorbidities. The treatment of mental relaxation sessions using mindfulness techniques: mindfulness of breath and body, and Muse's built-in brainwave entrainment. The results of measuring brainwave conditions inferred from the Muse™ application are compared. This study finds reflection on the practice of mindfulness on mental relaxation. Changes in deep relaxation occur when the client uses brainwave entrainment assistance compared to without using the default brainwave entrainment from the Muse™ application. Information on the Muse™ measurement app shows increased, lasting strength with each session. Clients run a total of twelve sessions of mental relaxation guidance. In each session, the client feels more comfortable using the help of brainwave entrainment. Even though the comparison of treatments showed different results, sleep problems and isolation during the pandemic were resolved through mindfulness sessions.

1 INTRODUCTION

In a study of 1.257 medical staff from 34 hospitals with fever clinics or COVID-19 patient wards in different regions of China, the majority of medical staff reported symptoms of depression, anxiety, insomnia, and distress, especially women, nurses, staff at Wuhan, and frontline health workers who directly treated or cared for patients with suspected or confirmed COVID-19 (Lai et al., 2020). Another report says the emergence of the 2019 coronavirus disease (COVID-19) is impacting healthcare workers' mental and mental health (Alnazly et al., 2021). Stress, isolation, and lack of access to resources are significant in the growing concern over newly discovered sleep disturbances and problems.

Several reasons can explain why some individuals have trouble sleeping. Increased daytime stress, anxiety, and distraction are apparent causes of sleep disturbances. However, other factors are rising, such as limited light exposure, lack of exercise, studying from home, changing sleep schedules and daytime routines, poor diet, and parenting demands. All are acting to worsen the ability to get a good night's rest. In Indonesia, this condition is not much different from several countries in other parts of the world experiencing the Covid-19 pandemic. The middle to lower-class economy has a significant impact.

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However, this certainly has an impact on the psychological aspect. Some clients who are used to monthly drug therapy also experience additional anxiety. This study narrates the extent to which the client's condition before and after guidance counseling is carried out.

2 PORTABLE ELECTROENCEPHALOGRAPHY (EEG) MUSE™ "S" ON MINDFULNESS PRACTICE

The Muse S — a multi-sensor meditation device that provides real-time feedback on brain waves, heart rate, and body movements — allows users to seamlessly switch from daytime meditation sessions to bedtime wear with comfortable, sleep-inducing fabrics—using advanced EEG technology to respond to the mind, heart, and breath. The Muse "S" is a comfortable brain-sensing headband that helps clients understand and track how well they are focusing, sleeping, and recharging so they can refocus during the day and recover each night. Muse's meditation library includes calming soundscapes for daytime use and responsive Go-to-Sleep Journeys for night-time sessions, inviting clients to explore relaxing lavender fields, forests, and underwater landscapes. Advanced EEG sleeps tracking from the client's bed.

2.1 Understanding Muse™ Meditation Data

At the end of each session, the researcher opens the client's results page data and uses the data as discussion points to understand better what was going on in his mind. Use a client's results chart to ask them to reflect on their mindfulness meditation experience. Ask curious questions about times when their mind is active, attention fluctuates, and whether they remember sustained periods of calm. For some descriptions of the signs contained in the Muse™ application are described as follows: (Workbook, 2018).

2.1.1 Calm Points

Calm Points are awarded for time spent meditating with a relaxed and focused mind. Receive 1 point every second the brain is in a natural resting (neutral) state and 3 points for every second spent focusing intensely on the breath (calm).

2.1.2 Bird Sounds

When the client finds deep, calm focus on the breath for a long time will begin to hear birds chirping. Over time, it will learn to use birds as cues to focus more on attention.

2.1.3 Recovery

When clients see the mind wandering and bring attention back, they are given rejuvenation. Recovery celebrates the moment from active (mind wandering/fluctuating attention) to neutral (a natural resting state). Recovery is critical to building focused attention skills and integrating the benefits of meditation into everyday life. Tap the graph to see the exact moment of resuscitation highlighted in orange.

2.1.4 Graphs

Client results in charts show what their brains are doing while they meditate and when they are in each state.

2.1.5 Active

It is time spent with a wandering mind. Attention fluctuates. The Client observing that the mind is active and returning attention to the breath builds mindfulness skills.

2.1.6 Neutral

It is a natural resting state. Attention does not fluctuate, but it only focuses a little.

2.1.7 Calm

Deep calm focus on the breath. These are the moments when concentrating on the breath. If it is quiet and focused long enough, it will hear the sound of a bird.

2.2 Effects of Mindfulness and Mental Relaxation Using Brainwave Entrainment on Sleep Disorders

Although someone is most likely to experience the consequences of a poor night's sleep, such as low energy, dizziness, and irritability (See also Kobayashi *et al.*, 2016; Zhang *et al.*, 2020; Amaerjiang *et al.*, 2021; Bhat and Chokroverty, 2021; LaGoy *et al.*, 2021; Hall and Coccaro, 2022; Moavero *et al.*, 2022; Ristanovic *et al.*, 2022; Schäfer *et al.*,

2022). Somebody may need to know all the benefits of mindfulness meditation for consistent quality sleep. Several studies show the benefits of mindfulness training (Berk et al., 2018; Cavic et al., 2021; Corbally & Wilkinson, 2021; du Plessis & Just, 2022; E., 2021; Eberth & Sedlmeier, 2012; Ihme & Sundstrom, 2021; Oliver et al., 2013; Pallozzi et al., 2017; Yoon-Suk Hwang et al., 2015). Consistent meditation practice has been shown to increase melatonin levels, which play an essential role in sleep regulation.

Activate someone's parasympathetic nervous system: Transcendental meditation techniques have been shown to activate one's parasympathetic nervous system. Alternatively, resting and digestive responses are crucial to bringing the body into a calm and relaxed state. While there is no best time to meditate during the day, meditation provides different benefits depending on when a person finishes the session. Meditating at night or before bed can help the client slow down their breathing and heart rate, which can help them move more quickly into the first stage of non-REM sleep. Sati (Pali: सति; Sanskrit: स्मृति smṛti), usually translated as "mindfulness" in early Buddhism, and examines its soteriological function and its central role in early Buddhist practice and philosophy. Using textual analysis and criticism, it takes a new approach to the subject through the comparative study of Buddhist texts in Pali, Chinese, and Sanskrit. It also provides a unique perspective on ancient teaching by applying findings in modern psychology (Kuan, 2007). The term mindfulness in this study intends to practice mental relaxation by paying attention to the breath and the body and using or without the help of brainwave entrainments, such as natural sounds, water, and the like.

The intervention or treatment in this study refers to attention to the body, in this case, the in and out breath and body sensations. The intervention was given twelve times. (I) given to clients using Muse™ Portable-EEG without brainwave entrainment in odd sessions, compared to (II) given to clients using Muse™ Portable-EEG with brainwave entrainment in even sessions. Measurements are monitored from the Mus® software. The mindfulness intervention used in this study does not fully use a particular approach, such as training courses based on the work of John Kabat-Zinn. However, the intervention was carried out by paying attention to the breath and the body's condition (Lin & Mai, 2018; Stelter, 2009).

3 METHOD

The method used for data collection in this study was a single-subject study with a design type of Alternating treatments with no baseline (without a no-treatment condition) or Type of Serial Treatment without a Pre-test (Richards, 2019). Data evaluation consists of the methods used to conclude changes in behavior. According to (Kleinhans et al., 2021), the fundamental purpose of serial treatment type design is to compare the effects of two more independent variables (treatment) on the same behavior.

Therefore, this is a potentially important design for researchers concerned with which interventional procedures are most effective. In applied research, where a single case design is used, experimental and therapeutic criteria are used to evaluate the data (Gehart, 2012). Experimental criteria refer to how data is evaluated to determine whether an intervention has an enforceable or verifiable effect on behavior. Experimental criteria are based on comparing behavior under different conditions, usually during the intervention and non-intervention (baseline) phases. The experimental criteria have been met to the extent that performance varies under these different conditions.

The therapeutic criterion refers to whether the effect of the intervention is significant. This criterion requires comparing the behavior change achieved and the level of change required for the client to function well in society. Even if behavior changes are feasible and related to experimental interventions, they may not be clinically or impliedly significant. To achieve therapeutic criteria, interventions must make essential changes in the client's daily functioning.

Data collection begins with a consultation in guidance and counseling sessions. Then treat them personally using mindfulness techniques—odd sessions without brainwave entrainment and even sessions using Muse's™ built-in brainwave entrainment. The researcher records body movements (if any) in the middle of the session. This counseling is part of implementing the Buddhist Guidance and Counselling Model (Girivirya, 2021). At the end of the session, the researchers interviewed post-treatment conditions.

4 RESULTS AND DISCUSSION

4.1 Measurement Results of Muse™

At the end of each session, the researcher opens the

client data. The intervention is carried out by (I) the client's odd session not using a headset (S1, S3, S5, S7, S9, S11); (II) in an even session, the client uses a headset to hear brainwave entrainment sounds (S2, S4, S6, S8, S10, S12). The sound of birds indicates the depth of the client's relaxed state while maintaining awareness of the breath going in and out. The results of the subject intervention are described as illustrated in the following chart by the point of calm.

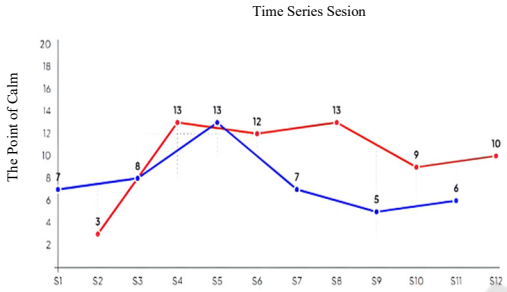

Figure 1: The Result of Intervention from Sessions 1-12.

4.2 Discussion

The advent of portable electroencephalography (p-EEG) or mobile(m-EEG) has created a means for collecting large-scale neural data. Thus, providing deeper insight into a phenomenon such as cognitive fatigue. According to (Krigolson et al., 2021), cognitive fatigue—an exaggerated nervous state with an increased incidence of incorrect performance—is responsible for everyday accidents that can sometimes claim human lives. To gain better insight into cognitive fatigue in the study, they tested the relationship between perceived fatigue and human event-related brain potentials (ERPs) and electroencephalographic oscillations (EEG) in 1,000 people. As a secondary objective, they further demonstrated m-EEG's ability to measure ERPs and EEG data accurately.

Many portable electroencephalographic (EEG) systems have been available to researchers in recent years. However, until recently, validation using low-cost EEG systems has been mounted on continuous EEG data or replication of large EEG system settings penning events to perform event-related checks (ERPs). Nowadays, it is even effortless to use by those unfamiliar with neuroscience. In this study, researchers used the first generation of Muse™ to help clients with problems.

Specifically, (Krigolson et al., 2017) report the results of two experiments using data collected with the MUSE EEG system—one using the well-known visual oddball paradigm and the other using a standard reward-learning task. The results show that from the study, observing and measuring the ERP components N200 and P300 in the eccentric visual task and positive imbalance (component opposite to negative feedback) in the reward learning task is possible. In particular, single-sample t-tests for the presence of components (all $p < 0.05$), calculation of credible Bayesian intervals, and 95% confidence intervals all statistically verified the presence of N200, P300, and positive payoffs in all analyses. They provide the research papers as an open-source website with all the instructions, methods, and software to replicate the findings and to provide researchers with an easy way to use the MUSE EEG system for ERP research. Importantly, our work monitors that one can efficiently perform ERP with a single computer and a portable EEG system such as MUSE. Thus, expanding ERP methodologies to new contexts is very likely.

Different from these studies, this research was carried out thoroughly. The single subject, whom we call the client in this study, complains of difficulty sleeping, post-stroke, living in a new environment, and isolation due to the co-19 pandemic. As shown in Figure 1, the treatment given to clients in odd sessions, without using brainwave entrainment, shows a lower state of calm (relaxation) than mindfulness using brainwave entrainment. These results are supported by research on the benefits of using brainwave entrainment concerning mental health (Collura & Siever, 2009; Dickson & Schubert, 2019; Schmid et al., 2020, 2021; Will & Berg, 2007).

A systematic Review by (Dickson & Schubert, 2019) says that some studies point to design flaws that might limit people's understanding of how music affects sleep. The most common problems identified were assumptions about music that were relaxing, catchy, or created expectations without ensuring that those assumptions were reasonable. Another issue that arises is the existence of interactions and mediators; with many studies, it is still being determined whether RPR (Six reasons the lead researcher proposed, how music helps sleep was identified in the literature) can fully explain why music can improve sleep quality. For example, they identified RPR that tended to operate like others, such as relaxation-mediated pleasure or distraction. It is crucial to present a broad and simplistic set of potential explanations for how music might help sleep as it reflects the state of the (somewhat limited) research and sets out vast possibilities that could lead to more valuable research without compromising credible RPR that has not yet been conducted tested through a well-founded methodological study.

Regardless of the Review. While the results of this study, for this client, apart from the results showing more silence from the Muse™ monitor. They were also demonstrated by observation and interviews after the session. Clients say that they are more comfortable listening to brainwave entrainment than without using brainwave entrainment. Likewise, observations during treatment sessions show fewer body movements when using brainwave entrainment. Similar to the results of this study, (Collura & Siever, 2009) shows a large and growing body of research and clinical experience demonstrates that Audio-visual Entrainment (AvE) quickly and effectively modifies conditions of high autonomic (sympathetic and parasympathetic) activation and over- and under-aroused states of mind, bringing about a return to homeostasis. AvE exerts a powerful influence on brain/mind stabilization and normalization through increased cerebral flow, levels of certain neurotransmitters, and by normalizing EEG activity. AvE is a safe and cost-effective treatment for many central and autonomic nervous system dysfunction disorders.

5 CONCLUSIONS

Reflecting on this research, mindfulness with the help of brainwave entrainment tends to help clients with post-stroke comorbidities become more relaxed and sleep better at night. The monitoring results of Muse™ measurably demonstrate this condition. Researchers do not use this as an independent technique. But in the part of special counseling sessions (one-on-one). However, researchers, or at the same time as counselors can carry out follow-up care to provide an understanding of behavior related to awareness, acceptance, and changes in post-stroke situations and conditions. The portable-EEG device and the Muse® application assist therapists and clients independently who show a trend of increasing quiescence with each session, primarily in brainwave entrainment on the Muse® apps, which provides bird sounds and the sound of the wind as reminders.

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AUTHOR CONTRIBUTIONS

The conceptualization of Model of Buddhist Counseling and Guidance and Analysis, S.G. and P.S.; Counselor, S.G.; Methodology Review, S.M., and R.I.; Data Collection, Review, and Analysis, S.

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