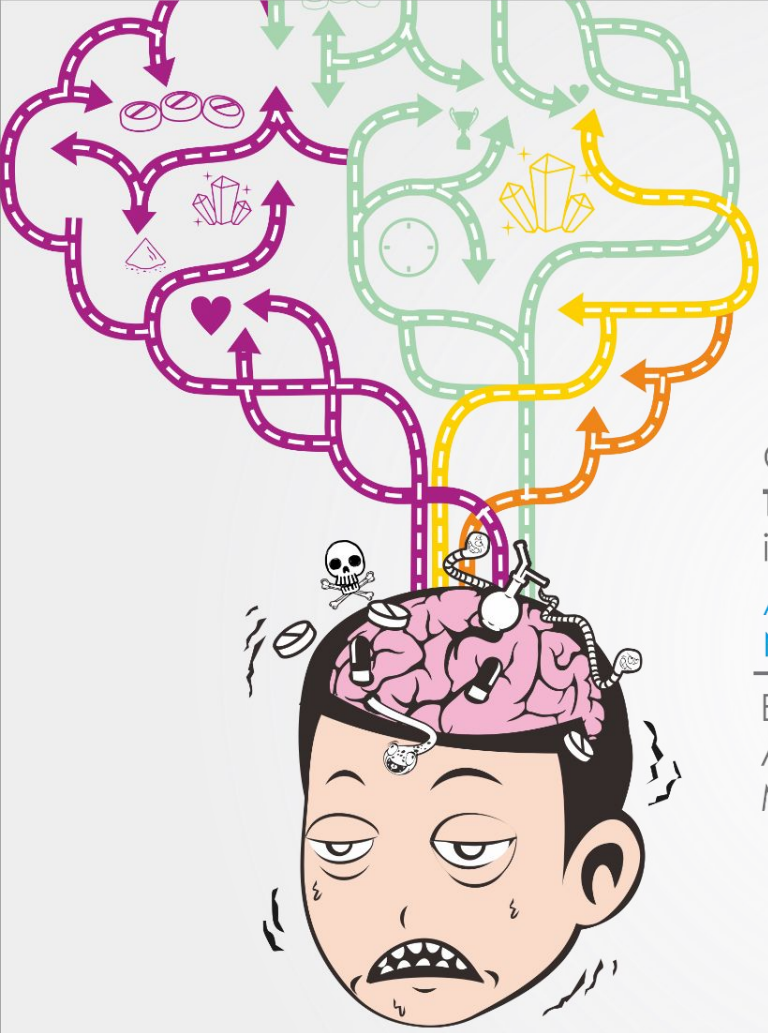


Clinical and Neurophysiological Evaluation of qEEG-Guided **Transcranial Magnetic Stimulation (TMS) Therapy** in Methamphetamine Dependence:

A Case Series Report
National Narcotics Board of Indonesia - Rehabilitation Center

Elvina Katerin Sahusilawane
Adre Mayza
Maharani

National Narcotics Board of Indonesia
Rehabilitation Center
(Balai Besar Rehabilitasi BNN)

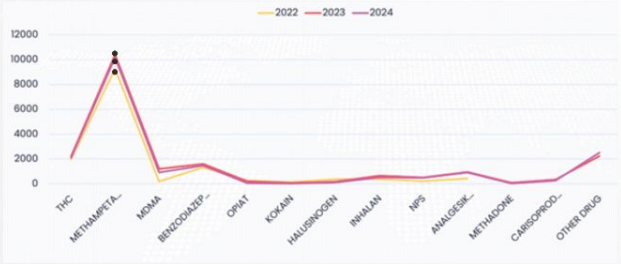
CURRENT SITUATION OF DRUG ABUSE: A GLOBAL AND INDONESIAN PERSPECTIVE

Global

World Drug Report 2024
(UNODC)

Indonesia

Indonesia Drug Report 2023

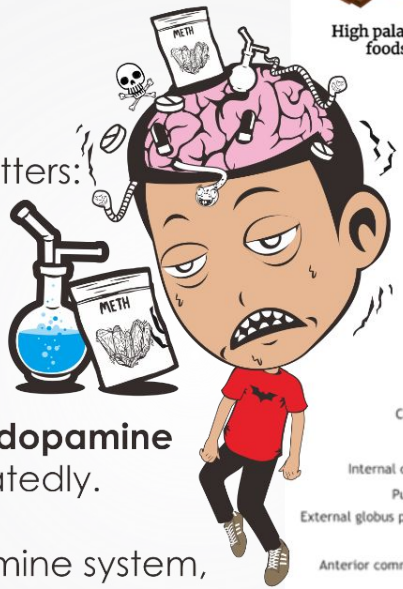


2019: 1,80%
2021: 1,95%
2023: 1,73% = 3,3 **million**

METHAMPHETAMINES DEPENDENCE

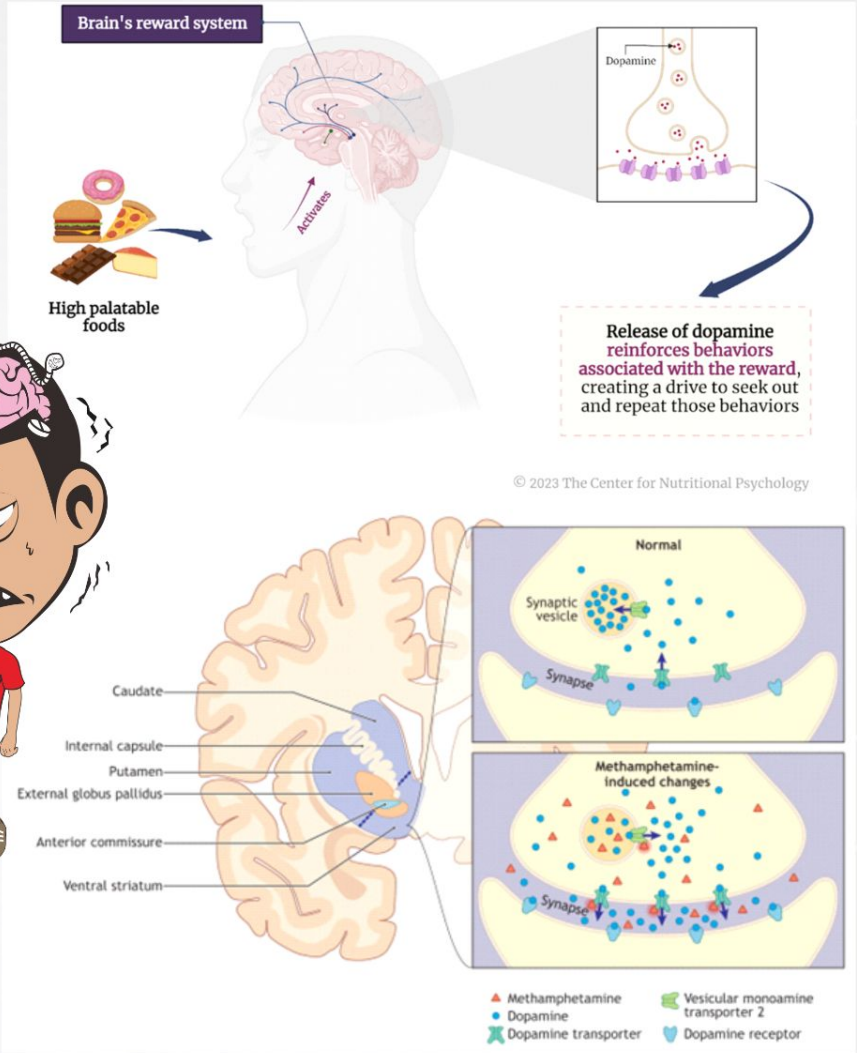
- The brain's reward system reinforces survival behaviors by releasing "feel-good" chemicals like dopamine.

- Methamphetamine stimulates the CNS by increasing monoamine neurotransmitters:
  - Dopamine
  - Serotonin
  - Norepinephrine



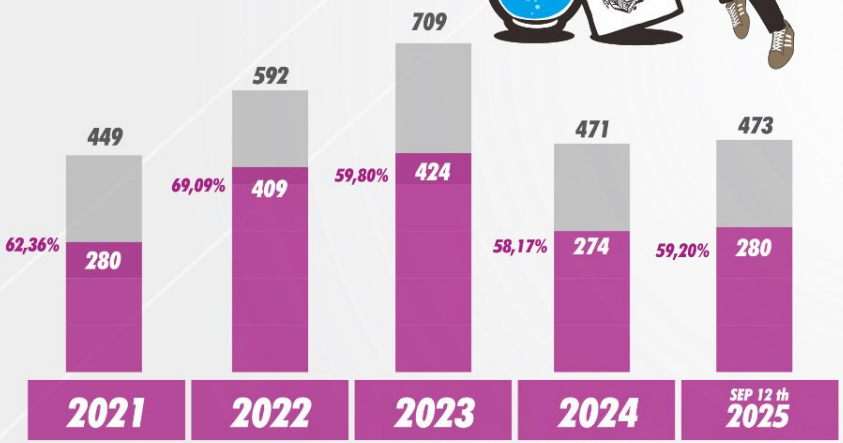
- Methamphetamine hijacks the reward system, releasing **excessive dopamine** like pressing a "dopamine button" repeatedly.

- Chronic use damages the brain's dopamine system, leading to:
  - Long-term cognitive impairment
  - Persistent emotional dysregulation



METHAMPHETAMINES DEPENDENCE

Data on clients with methamphetamine dependence in the **past five years**



Why Methamphetamine Addiction Is Hard to Treat ?

Meth causes long-term damage to the brain's dopamine system, affecting motivation, pleasure, and self-control

strong cravings and emotional instability, even after stopping use.

High relapse rates occur because the brain takes a long time to recover, and triggers can easily cause reuse.

Currently, there are **no FDA-approved** medications specifically for treating meth addiction.

There is a need for innovative therapies to complement existing rehabilitation programs.

TMS

TRANSCRANIAL MAGNETIC STIMULATION

DEFINITION

A non-invasive neuromodulation procedure
that employs magnetic fields to either excite
or inhibit neuronal activity
within targeted cortical regions of the brain

FUNCTION

To modulate neural circuits
implicated in addiction,
with the aim of reducing craving
and restoring brain function

The role of
Transcranial Magnetic Stimulation (TMS)
in addiction cases as an **adjunctive** therapy

- Targeting Damaged Brain Circuits,
  By stimulating the underactive prefrontal cortex,
  TMS can help **restore neurochemical balance**
  and enhance the brain's ability to control urges.

- By stimulating the prefrontal cortex,
  TMS can suppress the activity of
  the overly sensitive reward circuit.
  This effectively **reduces the intensity of craving**

- By targeting the same brain areas
  associated with depression,
  TMS can **improve mood** and reduce anxiety symptoms.
  With a more stable mental state,
  a person is better able to focus on their recovery.

AIMS OF PRESENTATION

- Explain the concept and mechanism of qEEG-Guided TMS as a novel therapeutic approach in addiction case.
- Present clinical and neurophysiological findings from a case study report at the National Narcotics Board (BNN).
- Draw conclusions on the future therapeutic potential of this approach.

TRANSCRANIAL MAGNETIC STIMULATION

Published Journal Articles on This Topic

Heliyon 10 (2024) e25065

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Review article

Applications of TMS in individuals with methamphetamine use disorder: A review

Mingming Zhang [a,b], Lei Chen [a,b], Ziwei Ren [a,b], Zhiyan Wang [a,b], Wenbo Luo [a,b,*]

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ARTICLE INFO

Keywords:
Methamphetamine use disorder
Transcranial magnetic stimulation
Treatment
Brain

ABSTRACT

Methamphetamine abuse results in a host of social and medical issues. Methamphetamine use disorder (MUD) can hinder the brain and impair cognitive functions and mental health. Transcranial magnetic stimulation (TMS) is a non-invasive approach in the treatment of MUD. Recent studies have demonstrated encouraging and positive effects of TMS on the craving, affective symptoms, sleep quality, and cognitive functions in individuals with MUD. The regulation of specific brain activities through TMS has also been found to be a contributing factor to these positive outcomes. It is essential to employ more techniques, participants, and stimulation parameters and targets in the future.

American College of Neuropsychopharmacology

www.nature.com/npp

ARTICLE OPEN

A systematic review and meta-analysis of neuromodulation therapies for substance use disorders

Dhvani D. Mehta[1,2✉], Angela Praschil[1,2], Heather B. Ward[3], Marcos Sanches[1], Maryam Sorkhou[1,2], Victor M. Tang[1,2], Vaughn R. Steele[4], Colleen A. Hanlon[3] and Tony P. George[1,2✉]

While pharmacological, behavioral and psychosocial treatments are available for substance use disorders (SUDs), they are not always effective or well-tolerated. Neuromodulation (NM) methods, including repetitive transcranial magnetic stimulation (rTMS), transcranial direct current stimulation (tDCS) and deep brain stimulation (DBS) may address SUDs by targeting addiction neurocircuitry. We evaluated the efficacy of NM to improve behavioral outcomes in SUDs. A systematic literature search was performed on MEDLINE, PsychINFO, and PubMed databases and a list of search terms for four key concepts (SUD, rTMS, tDCS, DBS) was applied. Ninety-four studies were identified that examined the effects of rTMS, tDCS, and DBS on substance use outcomes (e.g., craving, consumption, and relapse) amongst individuals with SUDs including alcohol, tobacco, cannabis, stimulants, and opioids. Meta-analyses were performed for alcohol and tobacco studies using rTMS and tDCS. We found that rTMS reduced substance use and craving, as indicated by medium to large effect sizes (Hedge's $g > 0.5$). Results were most encouraging when multiple stimulation sessions were applied, and the left dorsolateral prefrontal cortex (DLPFC) was targeted. tDCS also produced medium effect sizes for drug use and craving, though they were highly variable and less robust than rTMS; right anodal DLPFC stimulation appeared to be most efficacious. DBS studies were typically small, uncontrolled studies, but showed promise in reducing misuse of multiple substances. NM may be promising for the treatment of SUDs. Future studies should determine underlying neural mechanisms of NM, and further evaluate extended treatment durations, accelerated administration protocols and long-term outcomes with biochemical verification of substance use.

Neuropsychopharmacology (2024) 49:649–680; https://doi.org/10.1038/s41386-023-01776-0

ELSEVIER

Psychiatry Research

Volume 338, August 2024, 115995

Review article

Transcranial magnetic stimulation for methamphetamine use disorder: A scoping review within the neurocircuitry model of addiction

J. Ballester [a b], W.R. Marchand [b c d], N.S. Philip [e f]

https://doi.org/10.1016/j.psychres.2024.115995

IMPLEMENTATION OF TMS AT THE NATIONAL NARCOTICS BOARD REHABILITATION CENTER

- TMS has been applicated since 2021 for:
  - Methamphetamines withdrawal management
  - Craving management
- The study to evaluate the result after using TMS in managing Methamphetamines withdrawal symptoms has been done.
- The result showed significant improvement of withdrawal symptoms earlier (day 6) than control group (day 13).

CASE SERIES

QUANTITATIVE ELECTROENCEPHALOGRAPHY (qEEG)

- qEEG is a medical diagnostic tool
  that measures and analyzes electrical activity in the brain

- **Generate a "Brain Map"**
  (Topographical Map of neural activity):
  It presents the data as a visual map of the brain,
  using different colors to highlight areas of abnormal activity

- In this case series, EEG served as our navigation tool.
  By generating a detailed brain map,
  it enabled us to
  personalized and spatially precise TMS
  protocol direct with precision,
  ensuring we were targeting the disturbed brain circuits.

METHOD

- Case studies in **11 clients**
- Aim:
  evaluating the r**esult of TMS intervention guided by qEEG**
- 10 days of therapy, consecutively using protocols of:
  - **Continuous Theta Burst Stimulation (cTBS)**
  - **Intermittent Theta Burst Stimulation (iTBS)**
- Evaluations were assessed through:
  a. Clinical evaluations (pre- and post-treatment):
  - **Anamnesis (clinical interview)**
  - **Validated questionnaires:**
    (GAD-7, PHQ-9, PSQI, PSS-10, SCL-90)

  b. Neurophysiological assessments:
  Quantitative Electroencephalogram (qEEG)
- Period: **September 23 - November 23, 2024**

ELIGIBILITY CRITERIA

- **New clients or those who have completed the Physical and Psychosocial Monitoring & Evaluation phase, no later than 7 days prior to therapy.**
- **No severe mental disorders or infectious physical illnesses.**
- **Primary substance use history involves methamphetamine.**
- **No contraindications for TMS therapy, such as:**
  1. History of head injury causing loss of consciousness and/or concussion
  2. History of seizures or epilepsy
  3. Implants in the brain or cochlea
  4. Presence of a pacemaker
  5. Severe disorders in the ear region

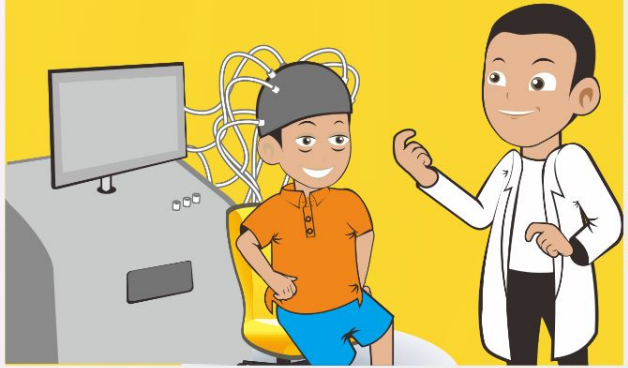
FRAMEWORK

1. INITIAL EVALUATION

Participants underwent clinical assessments (craving questionnaires, mental status evaluation) and neurophysiological assessments (qEEG recording).

2. TMS THERAPY

The intervention was administered according to a personalized protocol derived from qEEG data.



3. FINAL EVALUATION

Following a series of sessions, participants were re-evaluated using the same instruments to assess the observed changes.

EVALUATION OF CLINICAL SYMPTOMS—BASED ON ANAMNESIS

BEFORE TMS INTERVENTION

AFTER TMS INTERVENTION

BEFORE		AFTER	
10/11	**Sleep disturbances**	**Able to sleep earlier** stayed asleep throughout the night, enhance sleep quality, having no more nightmares, Improvement in sleep quality and duration	10/11
5/11	**Depressive symptoms** Feeling sad, lack of appetite, easily irritated, lack of confidence	**Depressive symptoms improved** Feeling less sad, feeling confident, not easily irritated, increase appetite	4/11
2/11	**Anxiety symptoms** Feeling stressed	**Anxiety symptoms** Feeling comfortable	2/11
1/11	**Difficult to adapt to new situation**	**Difficult to adapt to new situation**	0/11
2/11	**Psychotic symptoms** Auditory hallucinations, bad feeling toward other, fear of crowds	**Psychotic symptoms** Better at socializing with others	1/11
1/11	**Cognitive function disturbances** (difficult focusing and memorize)	**Cognitive function disturbances improved** Better at memorizing	1/11

EVALUATION OF CLINICAL SYMPTOMS—BASED ON QUESTIONNAIRES

- Instruments used in the Study:
  GAD-7, PHQ-9, PSQI, PSS-10, SCL-90

- **A total of 9 clients (81%)** showed improvement in scores on more than two types of questionnaires.

- **One out of 9 clients** demonstrated an increased score (worsening of symptoms) on the PSS-10 questionnaire, shifting from **mild** to **moderate stress.**

Improvements in psychological symptoms

anxiety, depression, stress, and sleep disturbances

EVALUATION OF NEUROPHYSIOLOGICAL ASSESSMENT—BASED ON QEEG RESULTS

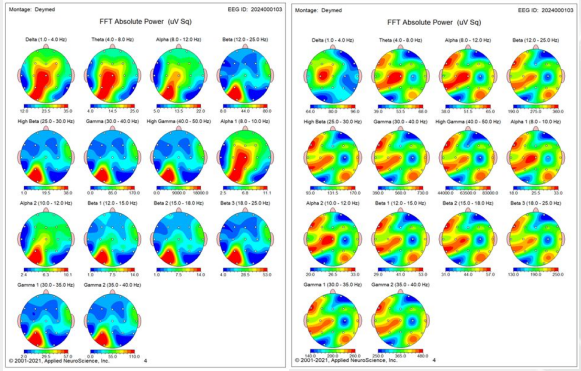
7/11	Sleep Disturbance	Improvement in sleep patterns	7/11
9/11	Anxiety/stress	Reduction in anxiety and stress	8/11
4/11	Attention Deficit	Improvement in attention and focus	3/11
3/11	Impulsive/Compulsive	Reduction in impulsive and compulsive behaviors	3/11
2/11	Memory Disturbance	Improvement in memory function	2/11
4/11	Irrational Thinking	Improvement rational Thinking	4/11
5/11	Demotivated	Increase in motivation	4/11
8/11	Poor emotion regulation	Improvement in emotional regulation	7/11
3/11	Cognitive ability	Enhancement of cognitive function	2/11

EVALUATION OF NEUROPHYSIOLOGICAL ASSESSMENT-BASED ON QEEG RESULT

- **5 clients (45%)**
  improvements at all brain stimulation sites
  (inhibition sites & excitation sites)

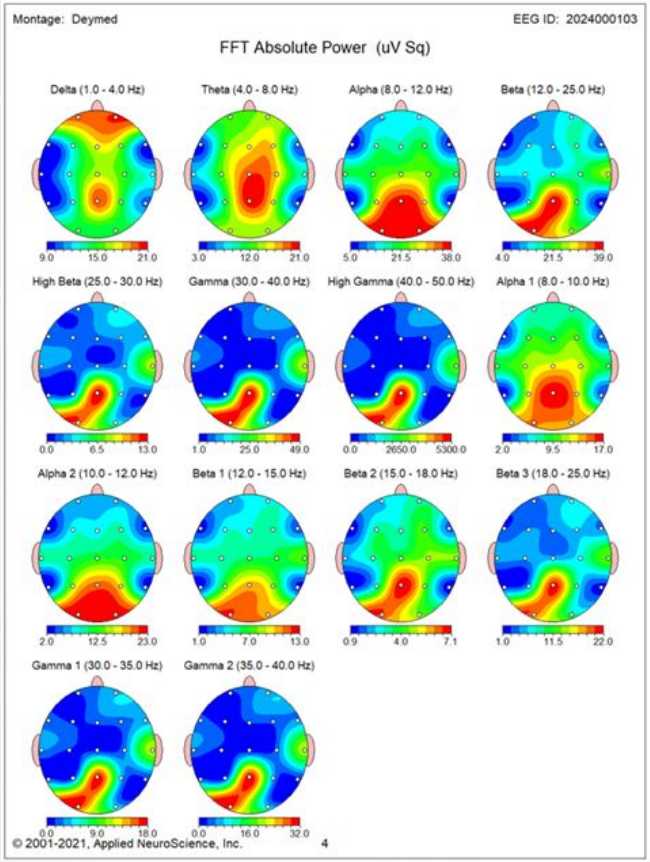
- **4 clients (36%)**
  improvements at one of the brain stimulation sites
  (3 clients at inhibition sites and 1 at excitation sites)

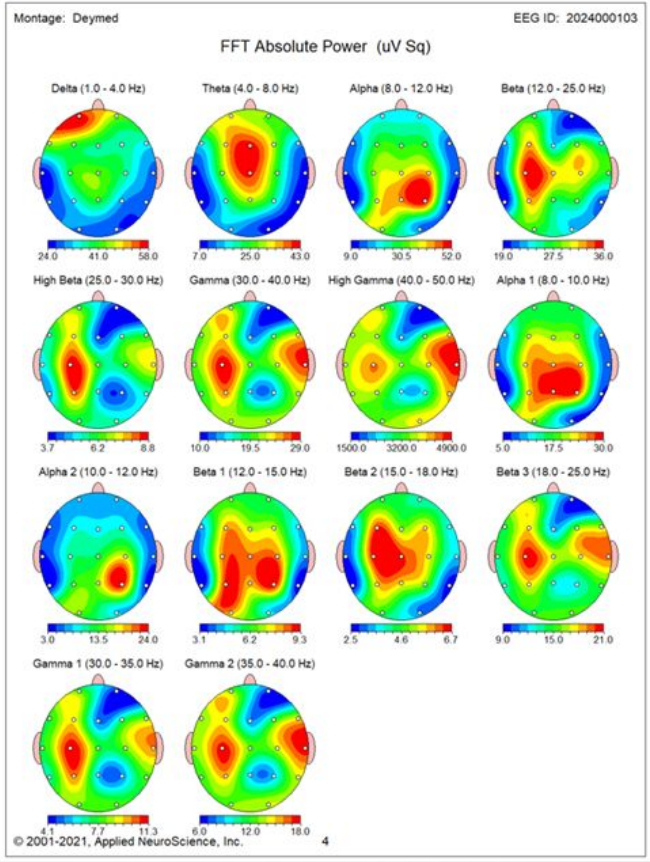
- **2 clients (18%)**
  no improvement
  consistent with the clinical symptoms



PRE & POST EVALUATION RESULT

PRE EVALUATION RESULT

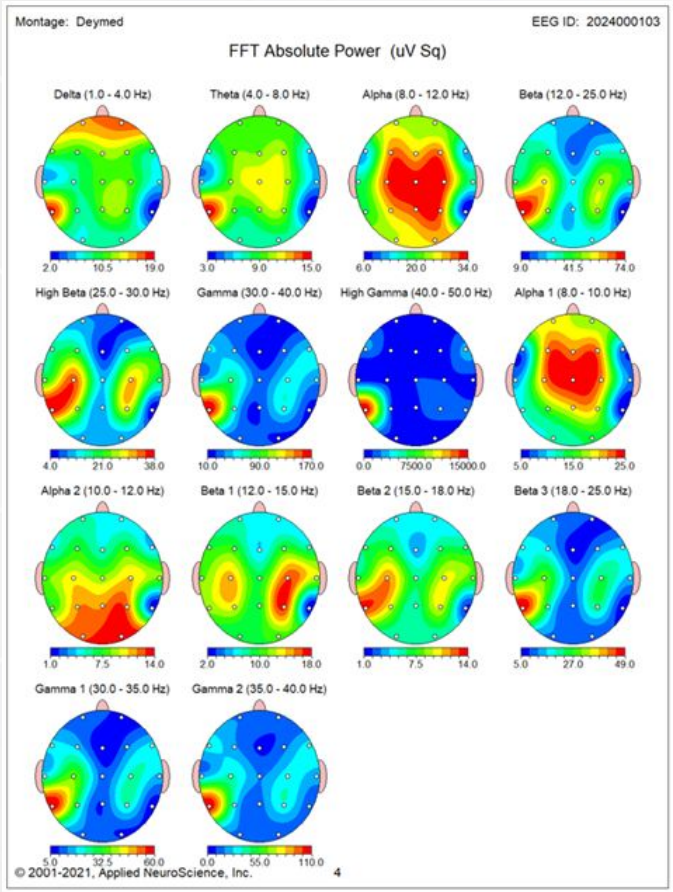


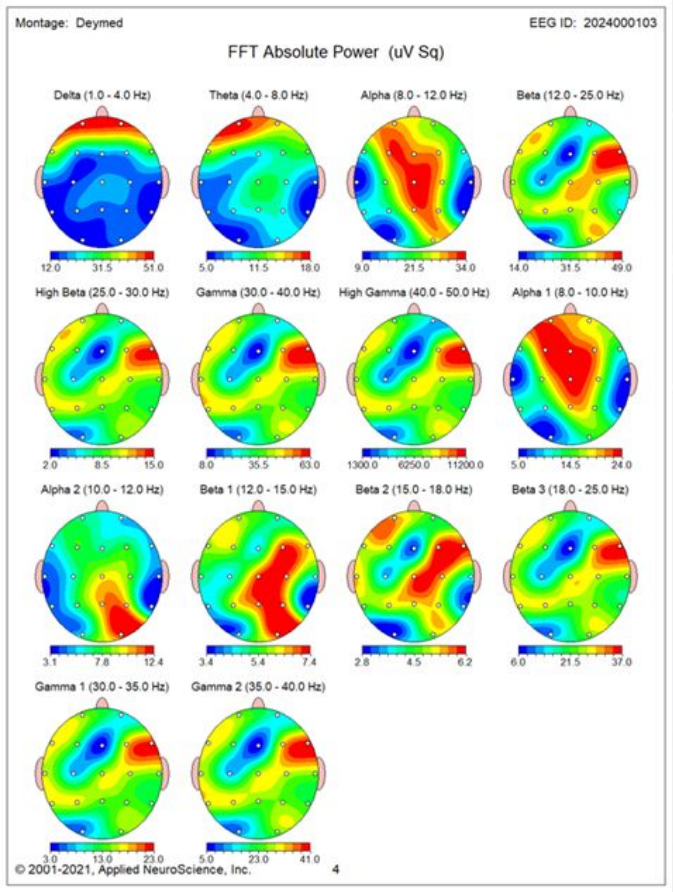


POST EVALUATI RESULT

PRE & POST EVALUATION RESULT

PRE EVALUATION RESULT





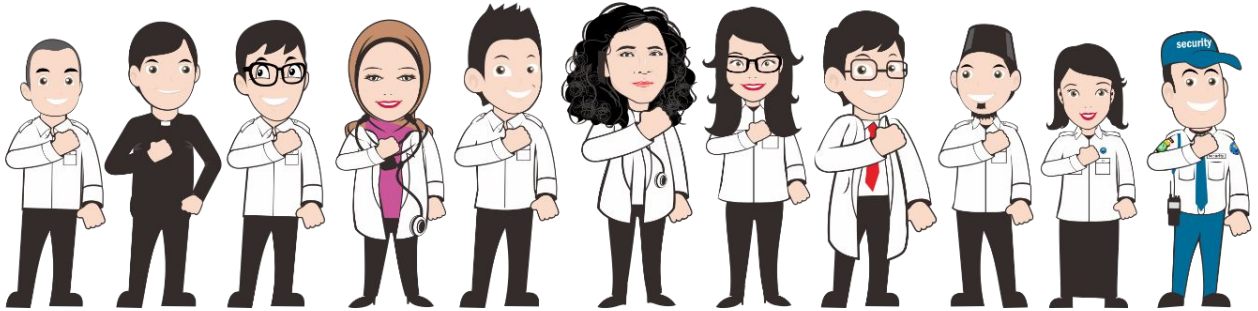
POST EVALUATI RESULT

CONCLUSIONS

qEEG-guided TMS therapy
has been demonstrated
to be safe and shows promising clinical
and neurophysiological outcomes
in reducing craving among individuals
with **methamphetamine addiction**.

RECOMMENDATIONS

- Future studies are recommended, including randomized controlled trials (RCTs) with larger sample populations, to strengthen the evidence base.
- TMS should be considered as an adjunct therapy to enhance the effectiveness of rehabilitation programs at BNN.



THANK **YOU**