

# Neuromodulation for Reducing Cravings and Relapse in Opioid Addiction: A Systematic Review and Meta-Analysis

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## Introduction

### What is the problem?

Traditional treatments (e.g., methadone, buprenorphine) show limited effectiveness for long-term relapse prevention.

### Why Neuromodulation?

Repetitive Transcranial Magnetic Stimulation (rTMS) and Transcranial Direct Current Stimulation (tDCS) are non-invasive techniques targeting craving-related brain regions.

### Study Objective

Assesses the efficiency of rTMS and tDCS for reducing opioid cravings and relapse in OUD.

## Methods

- Databases Searched: PubMed, PsycINFO, Embase, Cochrane.
- Inclusion Criteria: RCTs evaluating rTMS or tDCS for opioid use disorder (OUD).
- Primary Outcome: Craving reduction
- Secondary Outcomes: BDI-II, HDRS, DASS-21, PSQI, Relapse Function and Cognitive Function.
- Analysis: Random-effects model.
- Risk of Bias Assessment: Cochrane Risk of Bias Tool.

## Results

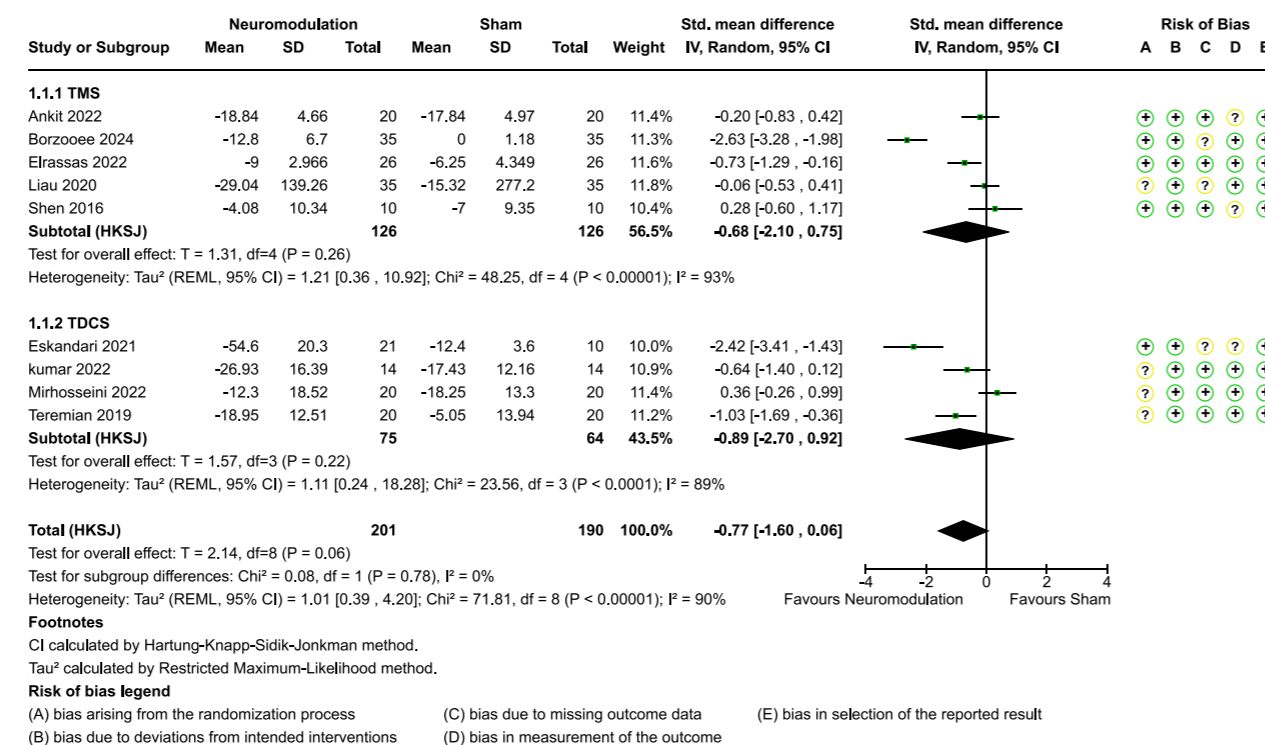
### Repetitive Transcranial Magnetic Stimulation (rTMS)

Author, year of publication	Sample Size			Country	Gender	Mean age/ Standard Deviation			
	Active group	Sham	Control			Male	Active group	Sham	Control
Shen et al., 2016	10	10	-	20	China	100%	41.4 ± 7.5	-	-
Lin et al., 2019	40	40	25	105	China	100%	33.95 ± 7.13	34.5 ± 8.54	38.56 ± 8.81
Liu et al., 2020	39	38	39	116	China	100%	39 ± 1.55	38.48 ± 1.44	38.71 ± 1.2
Tsai et al., 2021	11	9	-	20	Taiwan	80%	47.6 ± 8.7	47.7 ± 8.0	-
Jin et al., 2022	17	18	22	57	China	84.2%	46.1 ± 7.0	46 ± 5.4	48.2 ± 6.1
Ankit et al., 2022	20	20	-	40	India	100%	24.35 ± 4.18	25.5 ± 5.44	-
Elrassas et al., 2022	26	26	-	52	Egypt	100%	33	33	-
Biernacki et al., 2024	16	18	46	80	USA	58.7%	42.0 ± 10.0	46.0 ± 10.0	37.0 ± 12.0

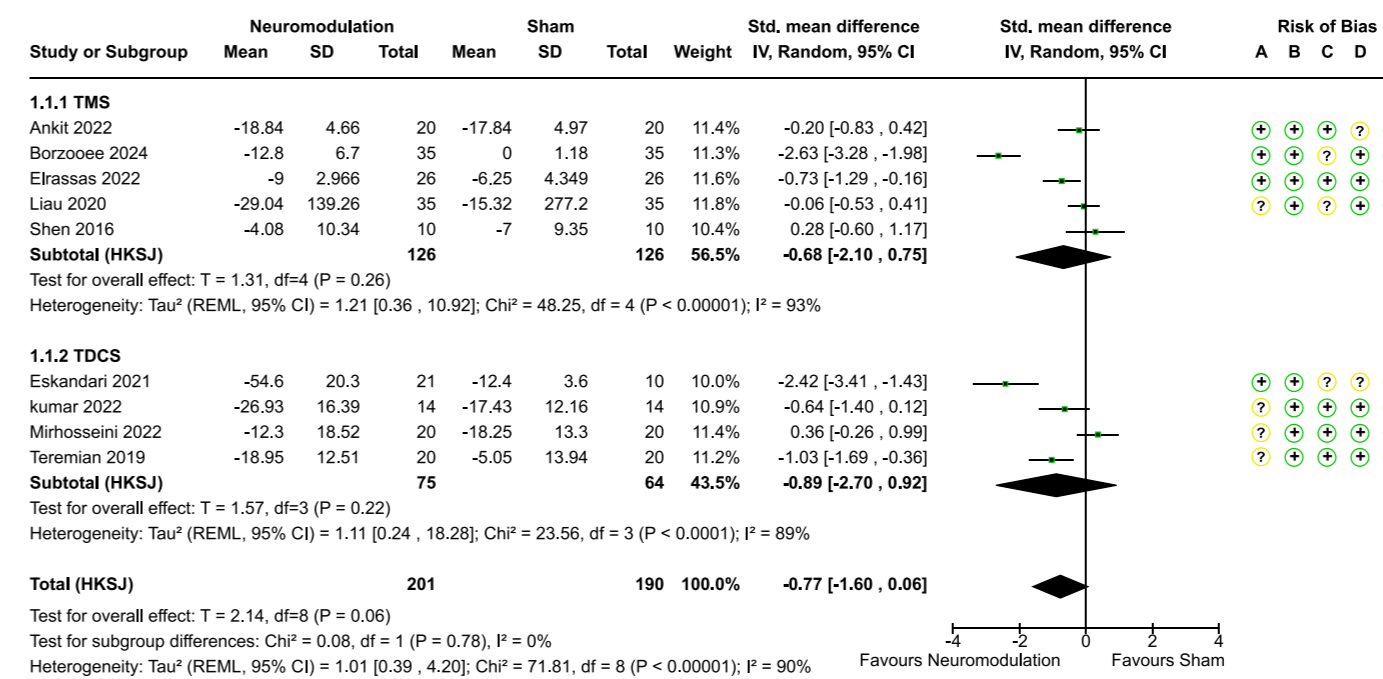
### Transcranial direct current stimulation (tDCS)

Author, year of publication	Sample Size			Country	Gender	Mean age/ Standard Deviation			
	Active group	Sham	Control			Male	Active group	Sham	Control
Wang et al., 2016	10	10	-	20	China	100%	39.8 ± 1.8	39.8 ± 1.8	-
Sharifi-fardhad et al., 2018	20	-	20	40	Iran	100%	37.95 ± 8.035	-	38.4 ± 7.014
Tareman et al., 2019	20	20	20	60	Iran	100%	33.45 ± 10.17	34.1 ± 9.31	32.24 ± 9.57
Bimorgh et al., 2020	14	13	0	27	Iran	100%	37.36 ± 7.63	36.00 ± 5.69	-
Eskandari et al., 2021	21	10	-	31	Iran	100%	34.4 ± 7.66	32.7 ± 9.34	-
Mostafavi et al., 2021	21	10	-	31	Iran	100%	34.4 ± 7.66	32.7 ± 9.34	-
Kumar et al., 2022	14	14	-	28	India	100%	23.93 ± 6.11	-	-
Mirhosseini et al., 2022	20	-	20	40	Iran	100%	25 (± 2.11)	-	26 (± 1.71)
Aksu et al., 2024	19	19	-	38	Turkey	94.70%	34.00 ± 13.00	30.00 ± 13.00	-
Borzoee et al., 2024	35	35	-	70	Iran	100%	39.5 ± 2.0	39.8 ± 9.6	-

### Forest Plot: Impact of Neuromodulation on Mood Symptoms in OUD



### Impact of rTMS and tDCS on Craving Scores: Forest Plot Analysis



## Discussion

Neuromodulation (rTMS & tDCS) shows potential as an adjunctive therapy for OUD, with rTMS demonstrating consistent craving reduction and tDCS showing potential cognitive benefits.

### Limitations

- Diverse craving and mood disorder scales (e.g., OCDUS, DDQ, SDS) impact data consistency.
- Heterogeneity across protocols (e.g., frequency, duration, electrode placement).
- Short follow-up durations prevent long-term effect evaluation.

## Conclusion

Further trials needed to refine protocols & assess long-term outcomes.

## References



Scan the QR Code for References.