

Repetitive Transcranial Magnetic Stimulation in Severe Alzheimer's Disease: A Meta-Analytic Evaluation of Cognitive Outcomes

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rTMS shows promising cognitive benefits in severe Alzheimer's disease, particularly in language-related domains, supporting its potential as an adjunctive therapeutic strategy in advanced-stage dementia.

Background

- Severe Alzheimer's disease (AD) is associated with profound cognitive decline and limited treatment options.
- Repetitive transcranial magnetic stimulation (rTMS) has emerged as a potential non-pharmacological intervention to enhance cortical excitability and cognitive function.
- Evidence in severe AD remains limited and inconsistent.
- Objective:** We conducted a meta-analysis to evaluate the effect of rTMS on cognitive outcomes in patients with severe AD.

Methodology

- A quantitative meta-analysis of Neurology studies indexed in PubMed evaluated the effects of **repetitive transcranial magnetic stimulation (rTMS)** in severe Alzheimer's disease.
- PubMed was searched from inception to December 2025.
- Search terms: "rTMS", "repetitive transcranial magnetic stimulation", "Alzheimer's disease" and "severe".
- Three studies** (5 controlled comparisons) were included.
- Total participants: **73**
rTMS group: **37**
Control group: **36**
- Cognitive outcomes assessed:
Picture-naming tasks
Mini-Mental State Examination (MMSE)
Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog)
- Effect sizes were calculated using **Hedges' g** under fixed- and random-effects models.
- Heterogeneity was assessed using **Q statistics** and **I² analysis**.

Results

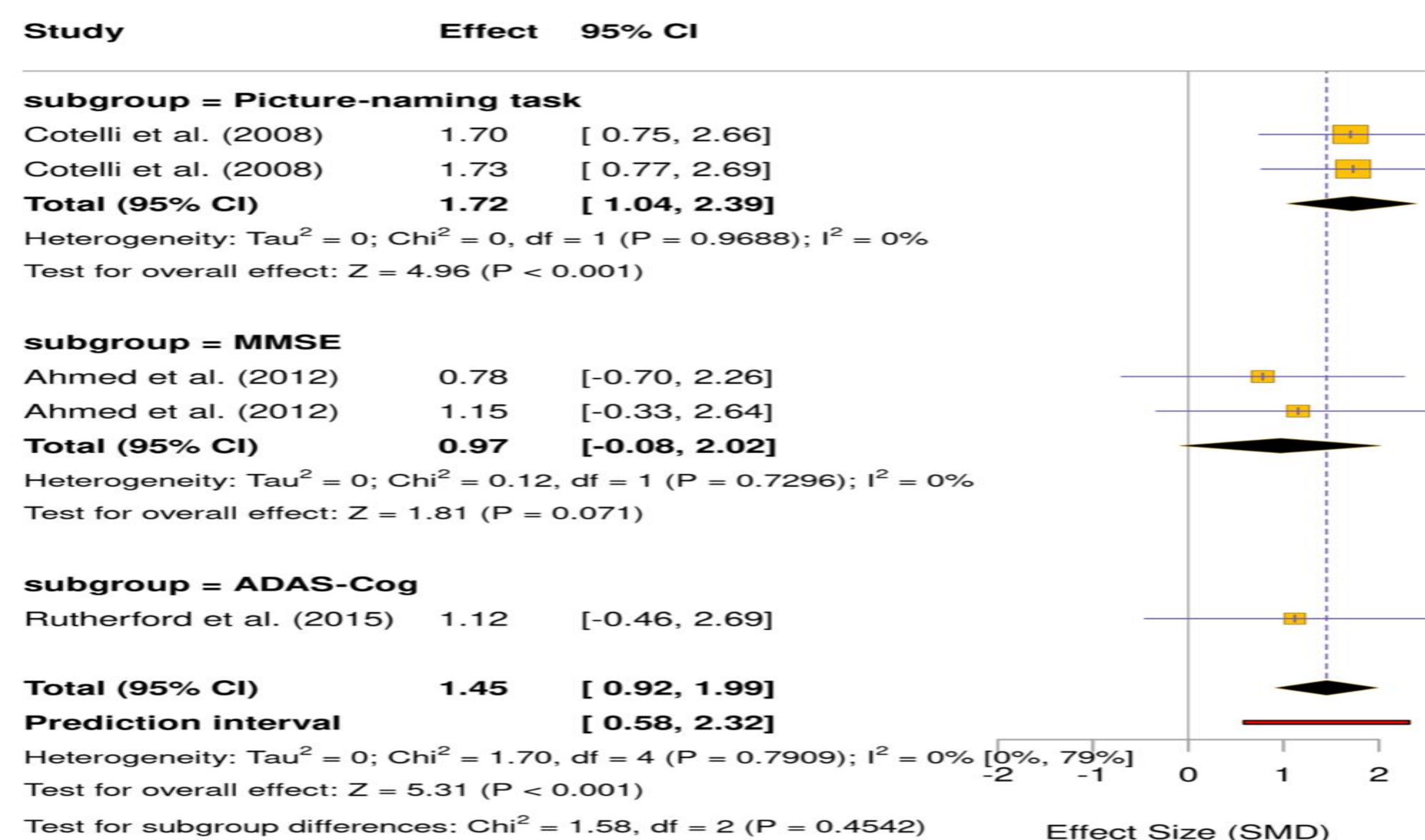


Figure 1. Forest plot showing pooled standardized mean differences of rTMS versus control on cognitive outcomes in severe Alzheimer's disease, overall and by task-based subgroups.

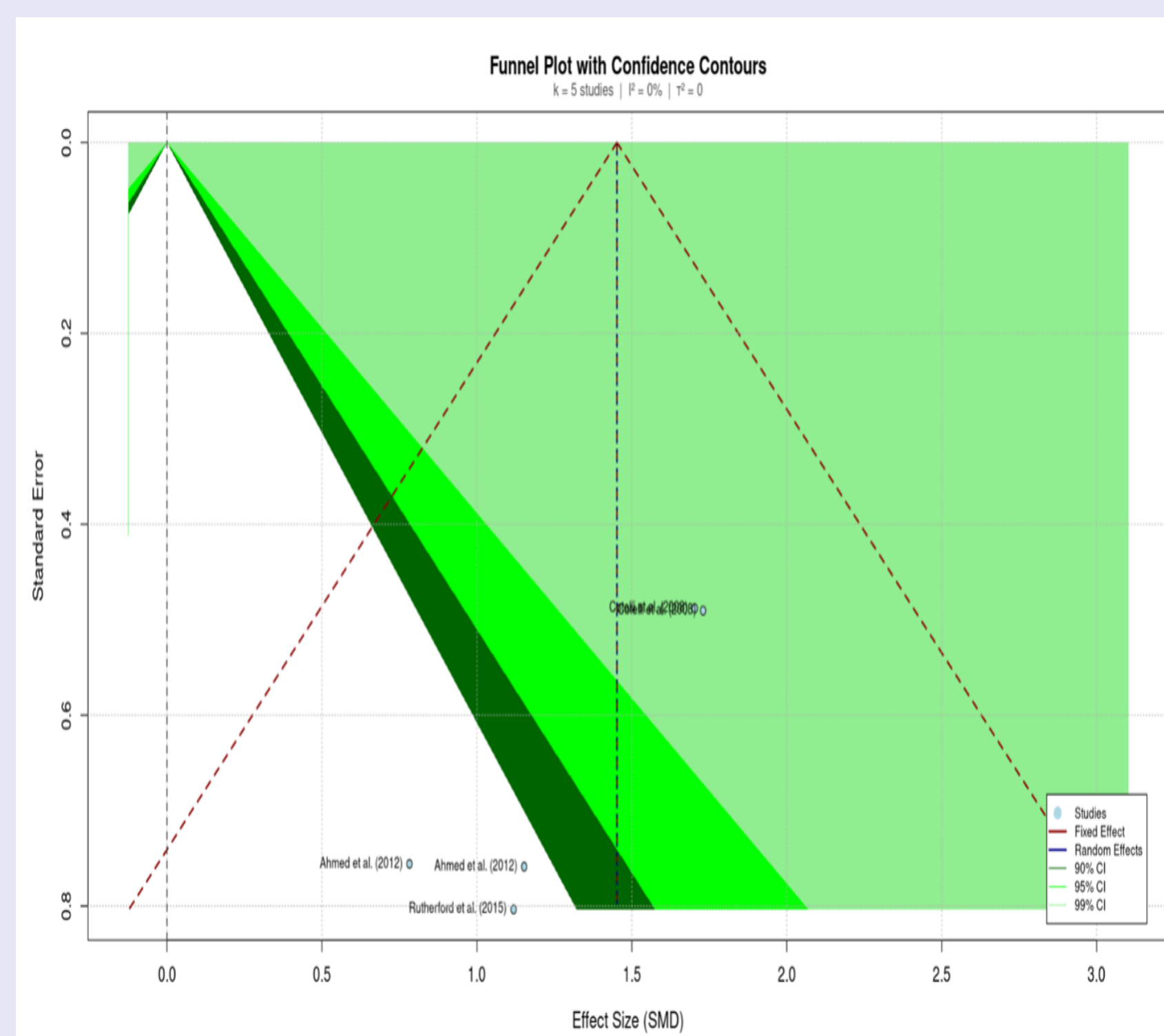


Figure 2. Funnel plot with confidence contours assessing small-study effects and publication bias in rTMS trials for severe Alzheimer's disease using standardized mean differences.

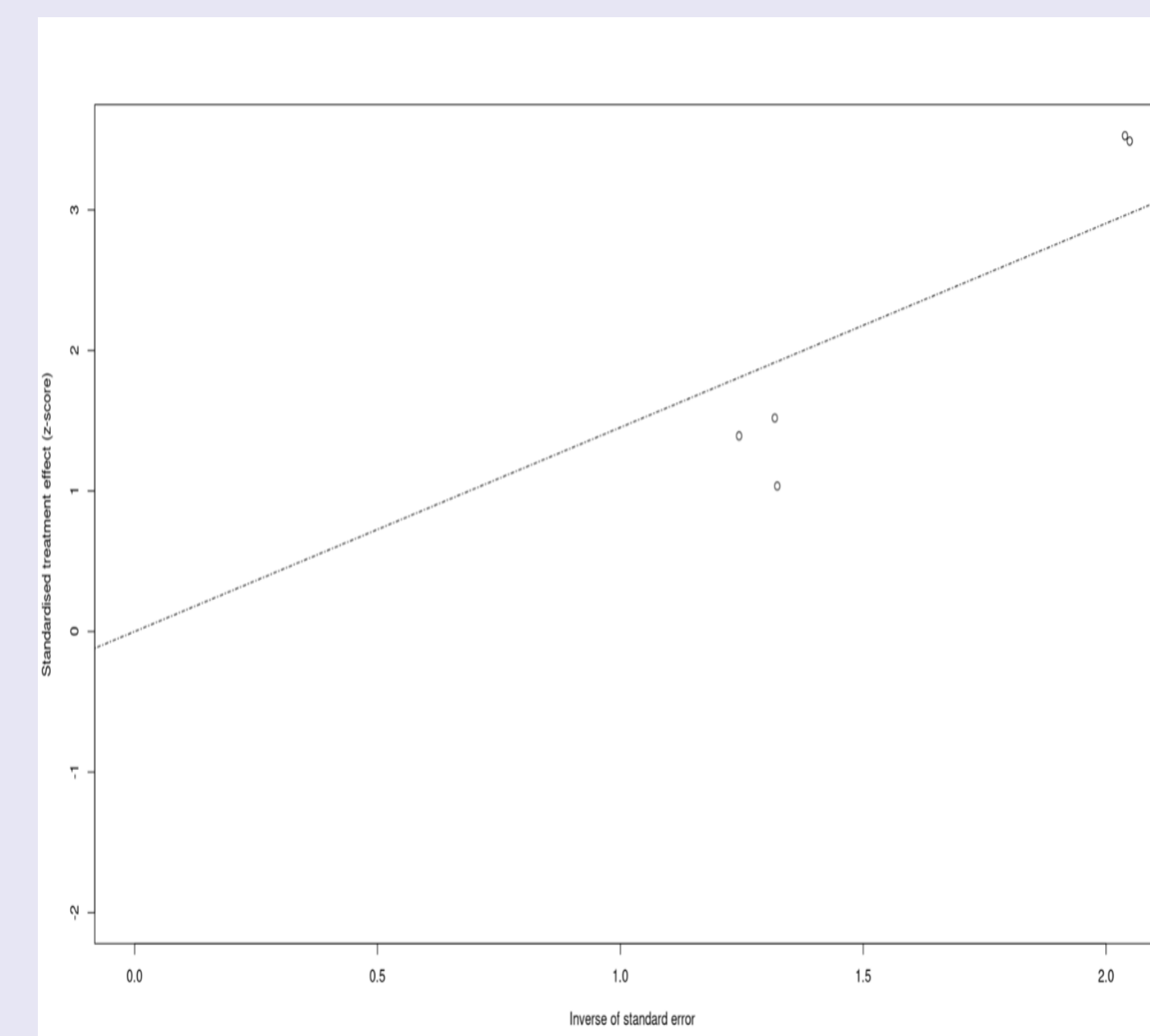


Figure 3. Galbraith plot assessing heterogeneity and outlier influence among rTMS studies in severe Alzheimer's disease using standardized treatment effects.

Conclusion

- rTMS demonstrated significant cognitive improvement** in severe Alzheimer's disease.
- The strongest effects were observed in **language-related domains**, particularly picture-naming performance.
- Consistent treatment effects and **low heterogeneity (I² = 0%)** support rTMS as a promising adjunctive strategy in advanced disease stages.
- Larger randomized controlled trials are needed to validate long-term efficacy, optimize stimulation parameters, and establish clinical applicability.

References

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