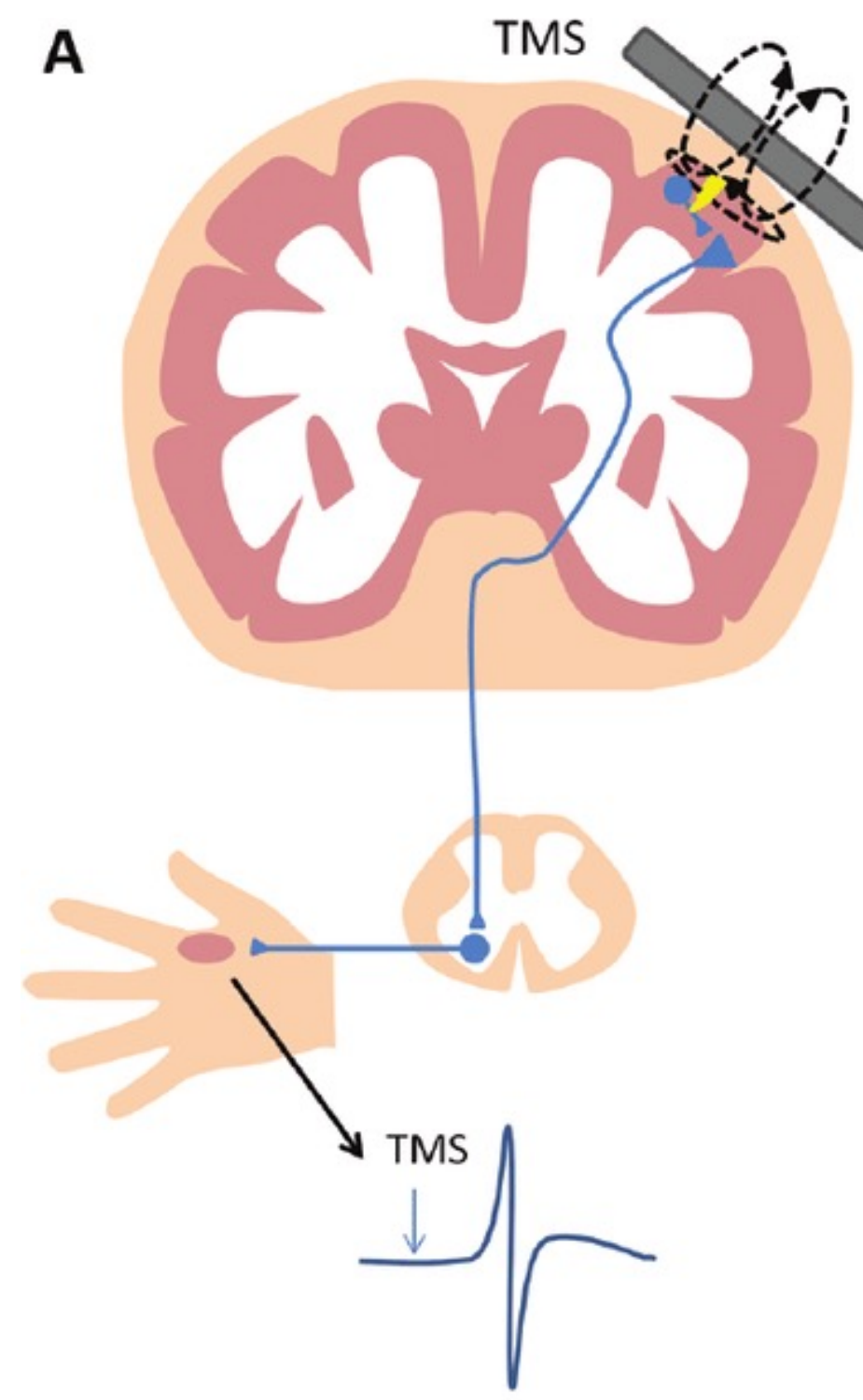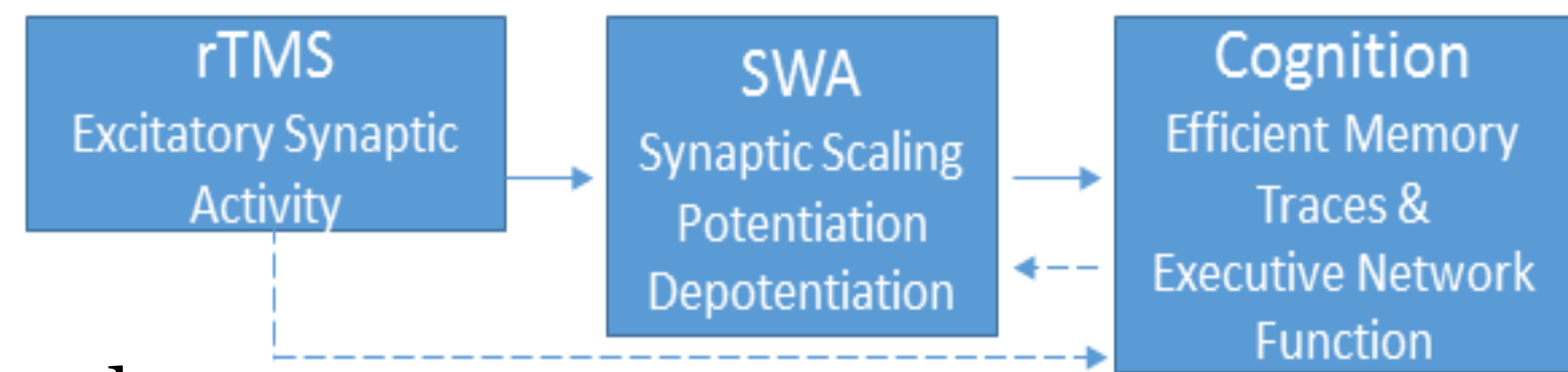# Potential Enhancement in Sleep Induced by Intermittent Theta Burst Stimulation for People with Moderate to Severe Worry

Yue Dong[1], Kristine A. Wilckens[2], Helmet T. Karim[2&3], and Carmen Andreescu[2]

1) University of Pittsburgh School of Nursing; 2,) University of Pittsburgh School of Medicine, Department of Psychiatry, 3) University of Pittsburgh School of Engineering, Department of Bioengineering

Background and significance

Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive and non-pharmacological measure for cortical function. rTMS has also been used to trigger slow wave activity, relating to memory consolidation and brain restoration[1&2].

rTMS — Excitatory Synaptic Activity → **SWA** — Synaptic Scaling Potentiation Depotentiation → **Cognition** — Efficient Memory Traces & Executive Network Function

Previous study:
- <u>Single session</u> high frequency TMS during wakefulness → increased slow-wave activity (SWA) during non-rapid eye movement (NREM) sleep in older adults with cognitive complaints
- Increased SWA: ++first period of NREM and whole night of NREM
- **However**, a decrease of sleep efficiency was observed despite increase in SWA

**STUDY AIM**: To examine change of sleep parameters as a function rTMS

Methods

PARTICIPANTS
- Secondary analysis: People with moderate to severe worry (Penn State Worry Questionnaire score >= 55)
- Item:

	Not at all typical	Rarely typical of me	Somewhat typical of me	Often typical of me	Very typical of me
If I don't have enough time to do everything, I don't worry about it.	5	4	3	2	1

STUDY DESIGN AND STATISTICAL ANALYSIS

>=4days	5 days a week * 2 weeks (10)	
Pre-TMS	rTMS	
	Adjustment (4)	Post-adjustment (6)
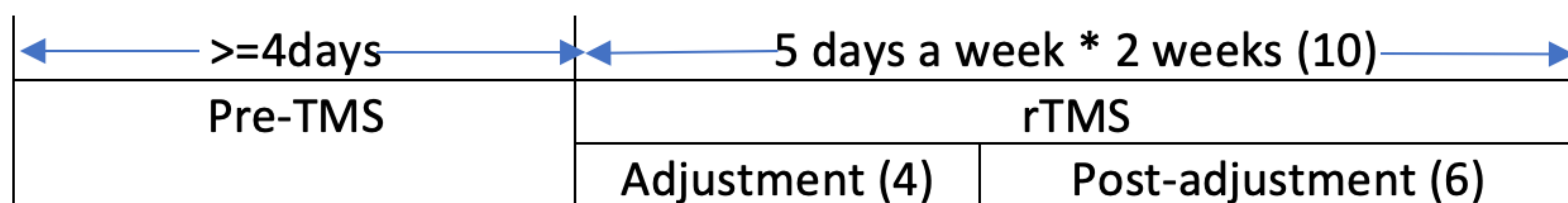
- Linear mixed effect modeling
  - compound symmetry as covariance type, parameter estimates for fixed effects as Model Statistics, Kenward-Roger approximation for repetitive measure, and participant ID as random effect
- Paired t-test, Hedge's g (within-subject difference) for effect size
- Natural log for SL, SE and WASO, and score alteration for TST and TIB

Participant characteristics
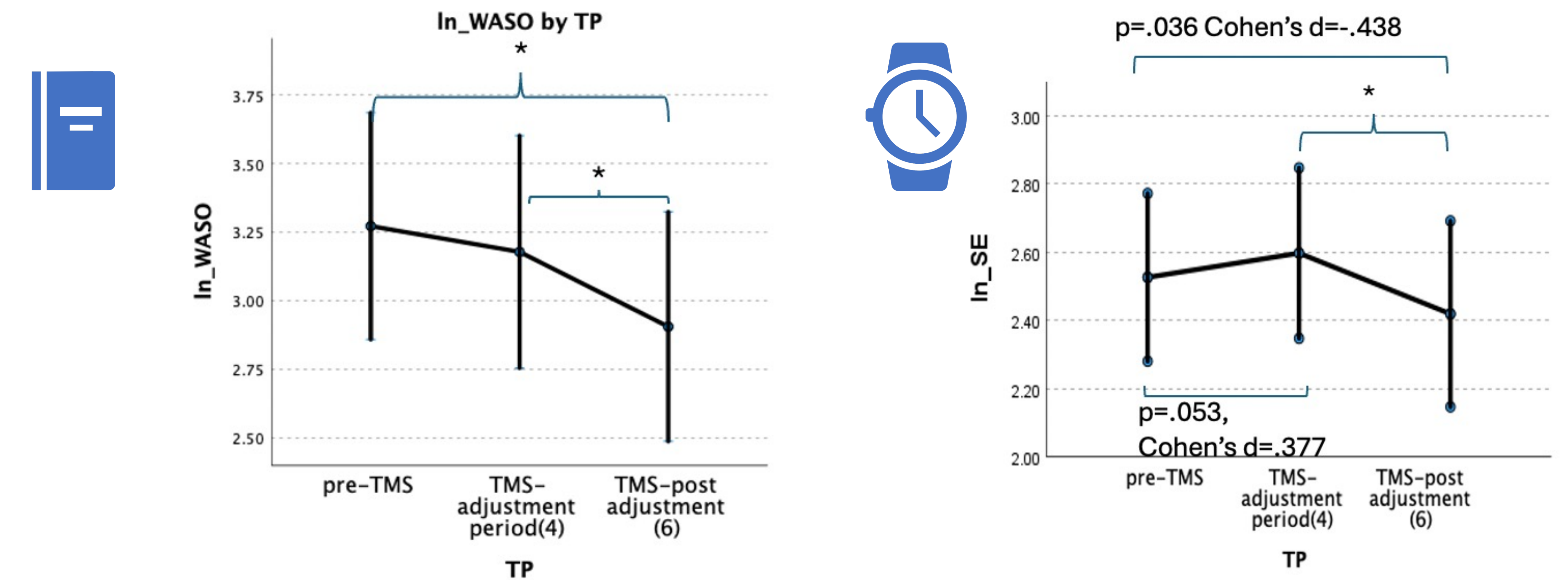
N	21
Age	57.77 (5.18)
N (female%)	14 (66.7%)
Race (White%)	16 (76.2%)
Employment (active%)	11 (52.4%)

28 consented → 21 completed
3 ineligible, 4 withdrew

1. Wilckens, Ferrarelli, Walker, Buysse, *Trends in Neurosciences, 2018*. 2. Huber, Ferrarelli, et al. *PLOS One*, 2007
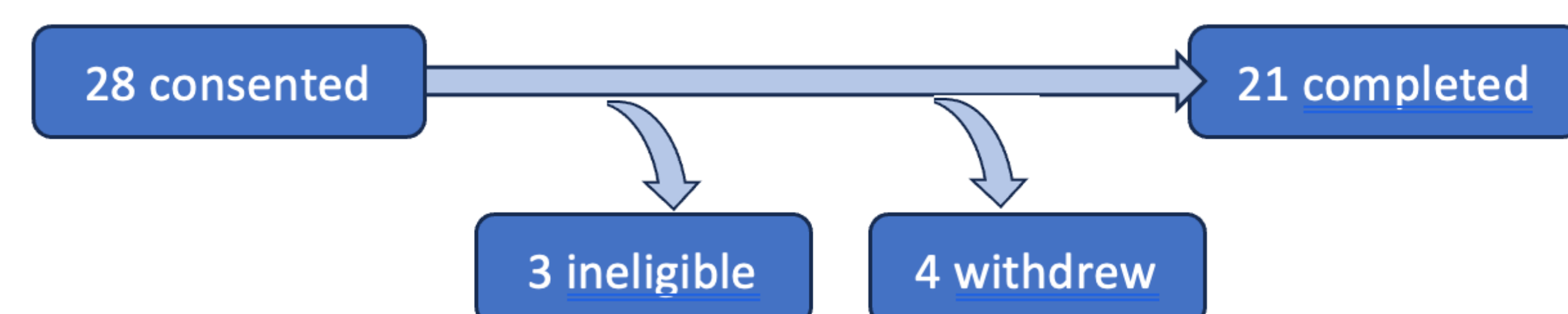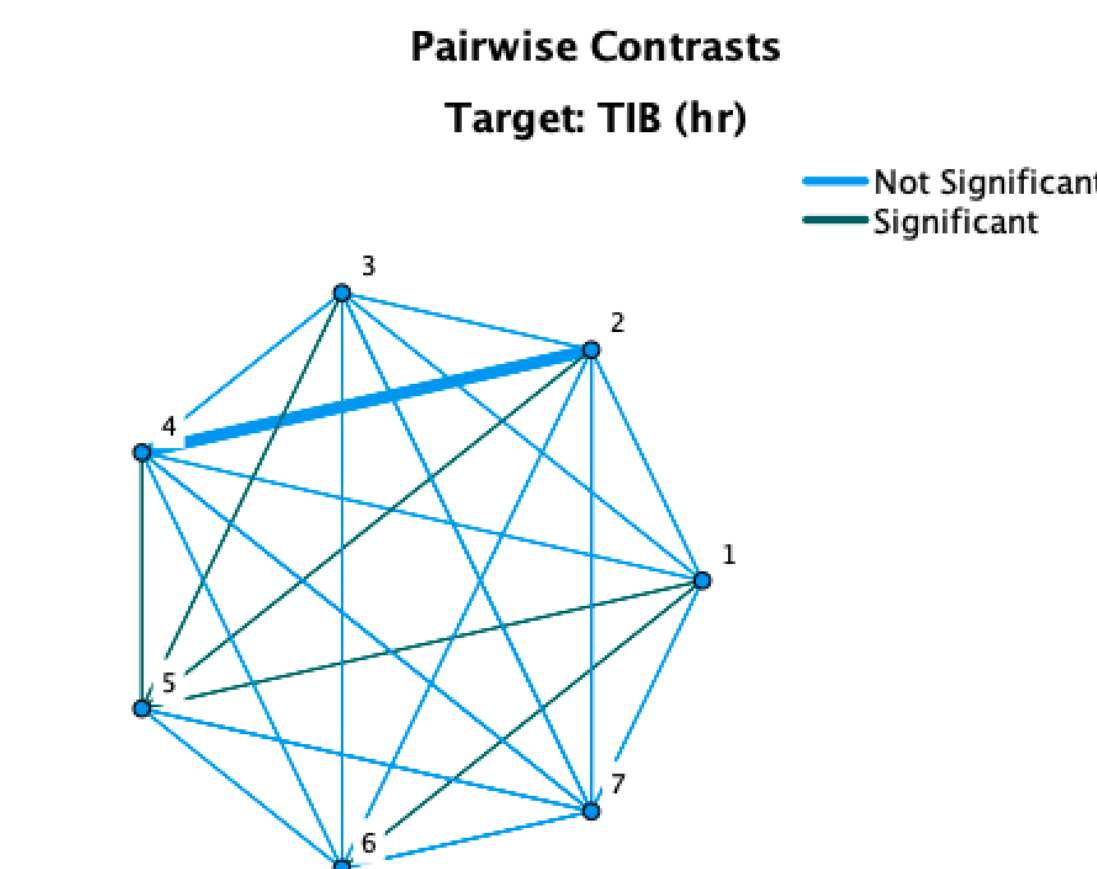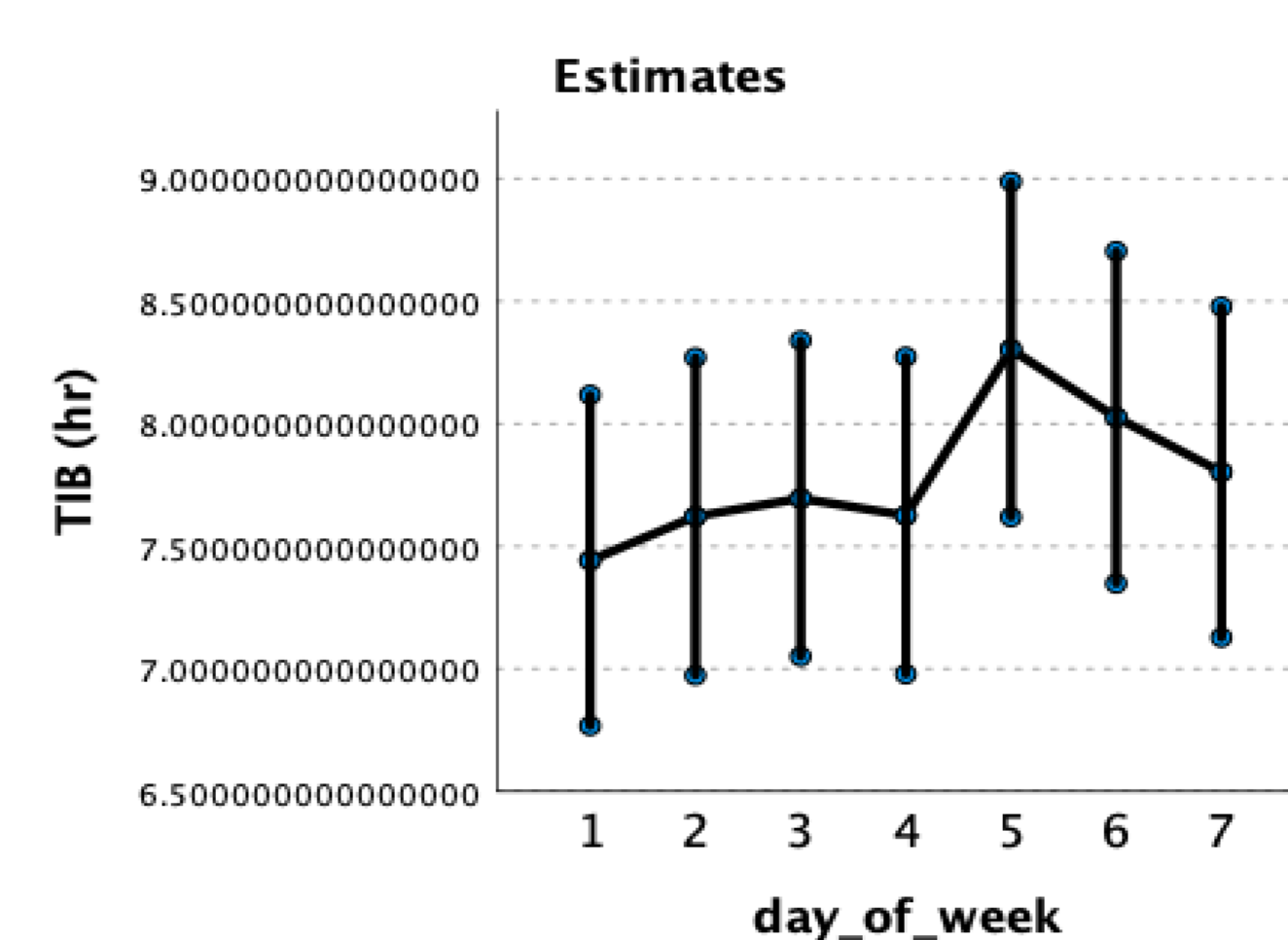
OUTCOME MEASURES:
- Objective: Actigraphy; Subjective: Sleep Diary
- Variables: time in bed (TIB), total sleep time (TST), Sleep efficiency (SE), wake after sleep onset (WASO), sleep onset latency (SL)
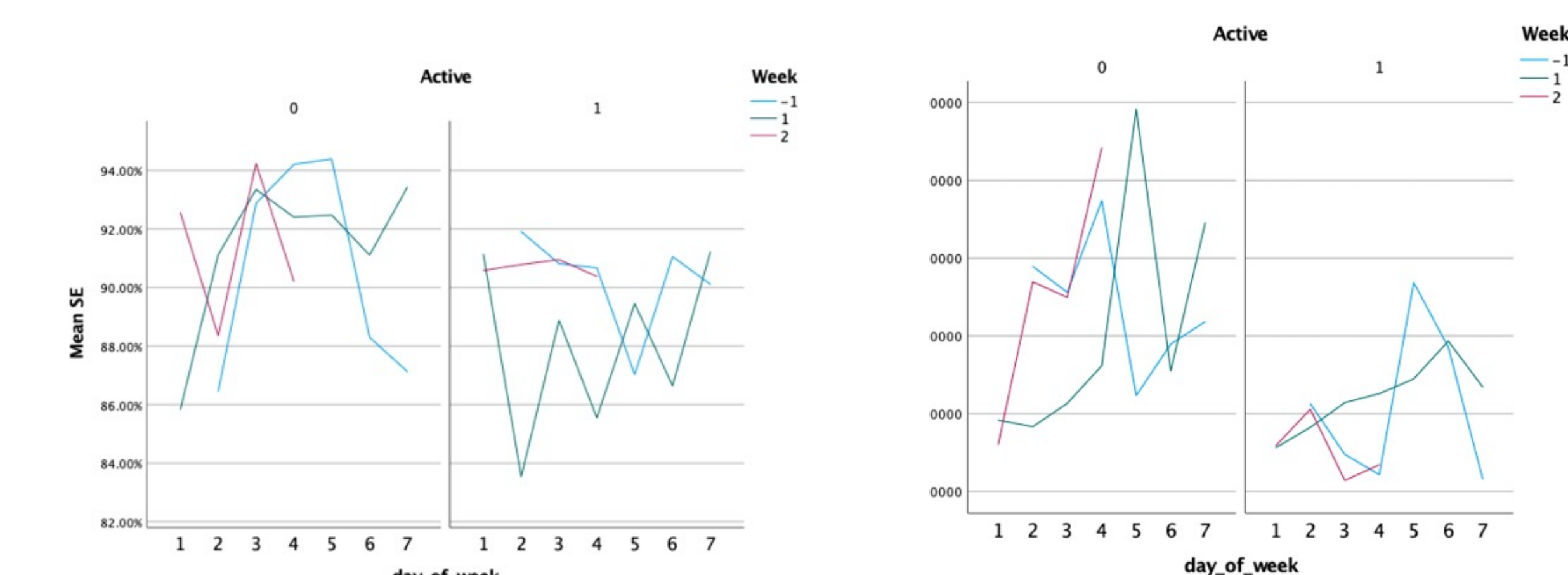
Results

ln_WASO by TP

p=.036 Cohen's d=-.438 ; p=.053, Cohen's d=.377

Day of the week effect

Estimates ; Pairwise Contrasts Target: TIB (hr)

Employment status effect

Discussion/ Conclusions

A pattern of adjustment for the initiation of rTMS was observed. Dairy data demonstrated a significant decline in WASO and Actigraphy demonstrated empirical increase in SE after rTMS, meaning that there is potential sleep enhance compared to baseline overcoming the first night effect.

Given the small sample size, analysis of the influence of covariance was not conducted. There is a potential day of the week effect and employment status effect on different TP. Sleep quality tends to increase during the weekends. Participants who is less active tend to have a higher TIB with more variance and a higher SE.

Limitations

1. small sample size& target population, 2. sample lack of diversity, 3. no post-study follow up measure for long lasting effect, 4. no precise sleep measures about SWA like PSG, weak link to cognition