

Resting State EEG in Patients with Parkinson's Disease and Healthy Controls Before and After Overnight Sleep: Preliminary Results

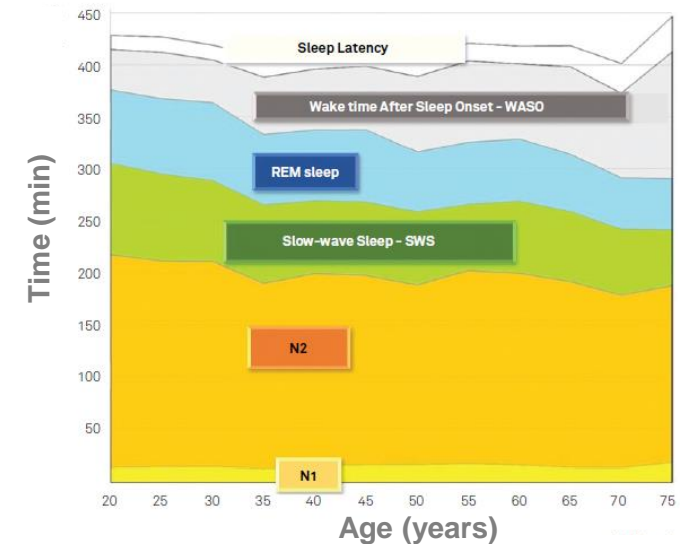
ISRS Mar 2024

Revital Shani-Hershkovich, PhD

Sieratzki-Sagol Institute for Sleep Medicine
Tel Aviv Medical Center (Ichilov)

Sleep in Aging and Neurodegeneration

- Sleep architecture changes with age (e.g., decreased TST & SWS)
- Sleep disturbances are common in aging populations
- Neurodegenerative diseases such as Alzheimer's and Parkinson's are linked with disrupted sleep patterns
- Sleep is disrupted differently in AD and PD
 - AD: insomnia, sleep fragmentation
 - PD: REM sleep Behavior Disorder (RBD)
- Disrupted sleep may accelerate cognitive decline and worsen symptoms



Parkinson's Disease (PD)

- A chronic progressive disease of the nervous system (autonomic and central)
- 2nd most common neurodegenerative disease after Alzheimer's
- Affects ~1% >60y worldwide
- males > females
- Loss of dopaminergic neurons in the brain cause motor symptoms

Parkinson's Disease and Sleep

- General sleep disturbances
- Specific:
 - REM Sleep Without Atonia (RSWA): loss of muscle atonia during REM
 - REM Sleep Behavior Disorder (RBD): dream-enactment behaviors during REM
 - RBD predicts PD ~10 years prior to diagnosis

Parkinson's Disease Studies at the Sleep Institute:

- Several running studies on sleep in PD
- This project:
 - Resting state EEG activity (while awake) immediately before and after overnight sleep
 - Ongoing, preliminary results

Aim and Hypothesis

Aim

To characterize resting state brain activity of PD and healthy controls using EEG before and after sleep.

Hypothesis

- (1) Parkinson's disease will affect the resting state EEG activity pattern
- (2) The affected pattern will be different at pre- and post-sleep

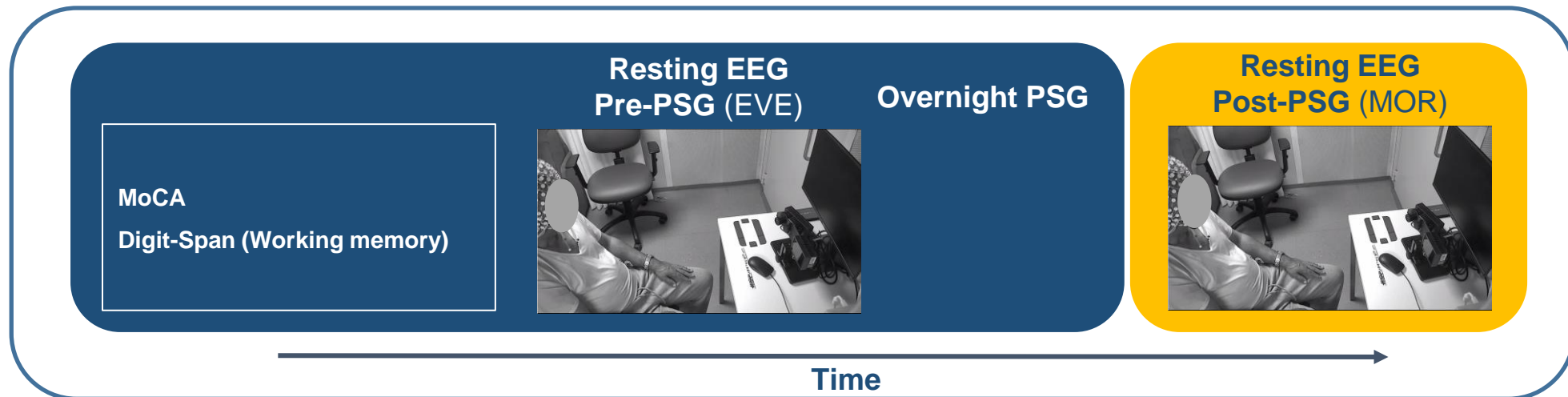
Methods

Study population

10 PD and 10 HC matched for gender and age

EEG recording

- High density EEG, 256 electrodes (EGI)
- 4 minutes eyes closed in resting state
- Recorded before and after overnight PSG



Inclusion/Exclusion Criteria

Inclusion Criteria:

- Age 50-80
- MoCA \geq 22
- For patients: all disease stages

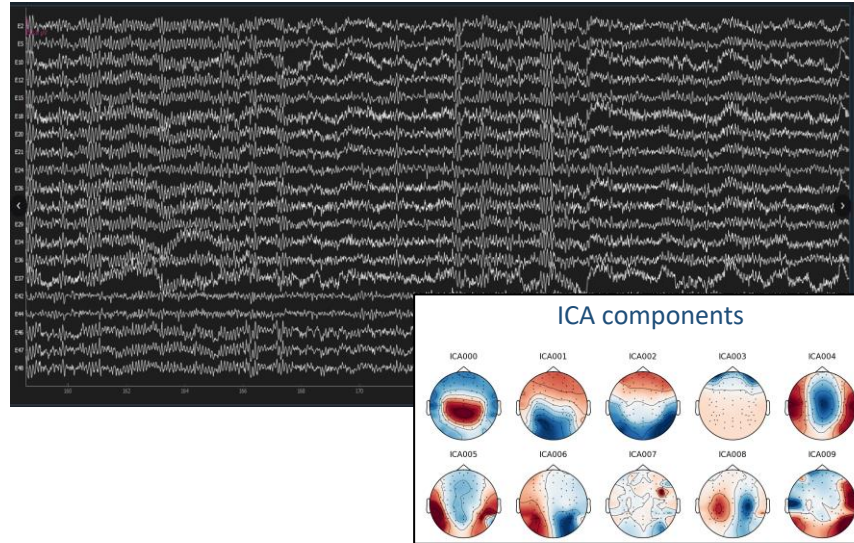
Exclusion Criteria:

- Diagnosed with other neurological or psychiatric disorders
- Medications: anti-depressants, anti-psychotic, cholinergic and sleep medications

Demographics and Clinical Characteristics

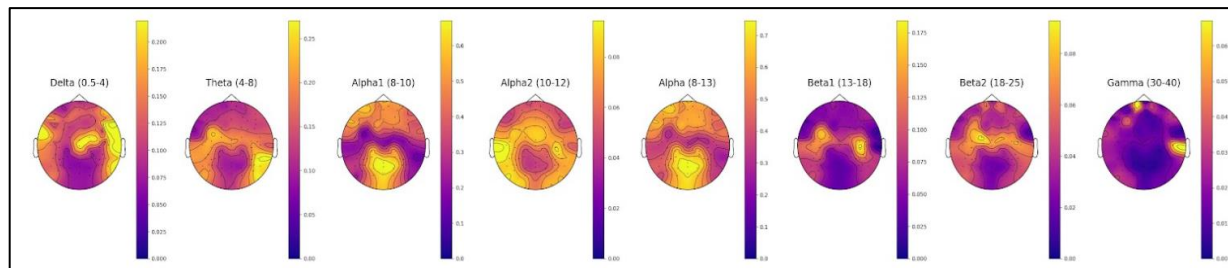
	PD	HC	p-val
N (%F)	10 (50%)	10 (50%)	
Age mean (range)	64.7 (57-81)	61.7 (50-75)	n.s.
Disease stage H&Y mean (range)	1.55 (1-3)		
mUPDRS	19.4		
Dopaminergic meds	3/10		
RBD	1/10		
MoCA mean (range)	27.5 (24-29)	28 (26-30)	n.s.
Digit Span mean (range)	17.8 (8-26)	19.5 (17-24)	n.s.

EEG Processing



Preprocessing

- Filter 0.5-40 Hz
- Remove & interpolate bad electrodes
- Mark bad epochs
- Remove artifacts with ICA
- Number of electrodes reduced from 256 to 64, according to the 10-10 international system
- re-referencing to average of all electrodes



Topographic maps

Compute Relative Band Power

Frequency bands:

Delta (0.5-4 Hz)

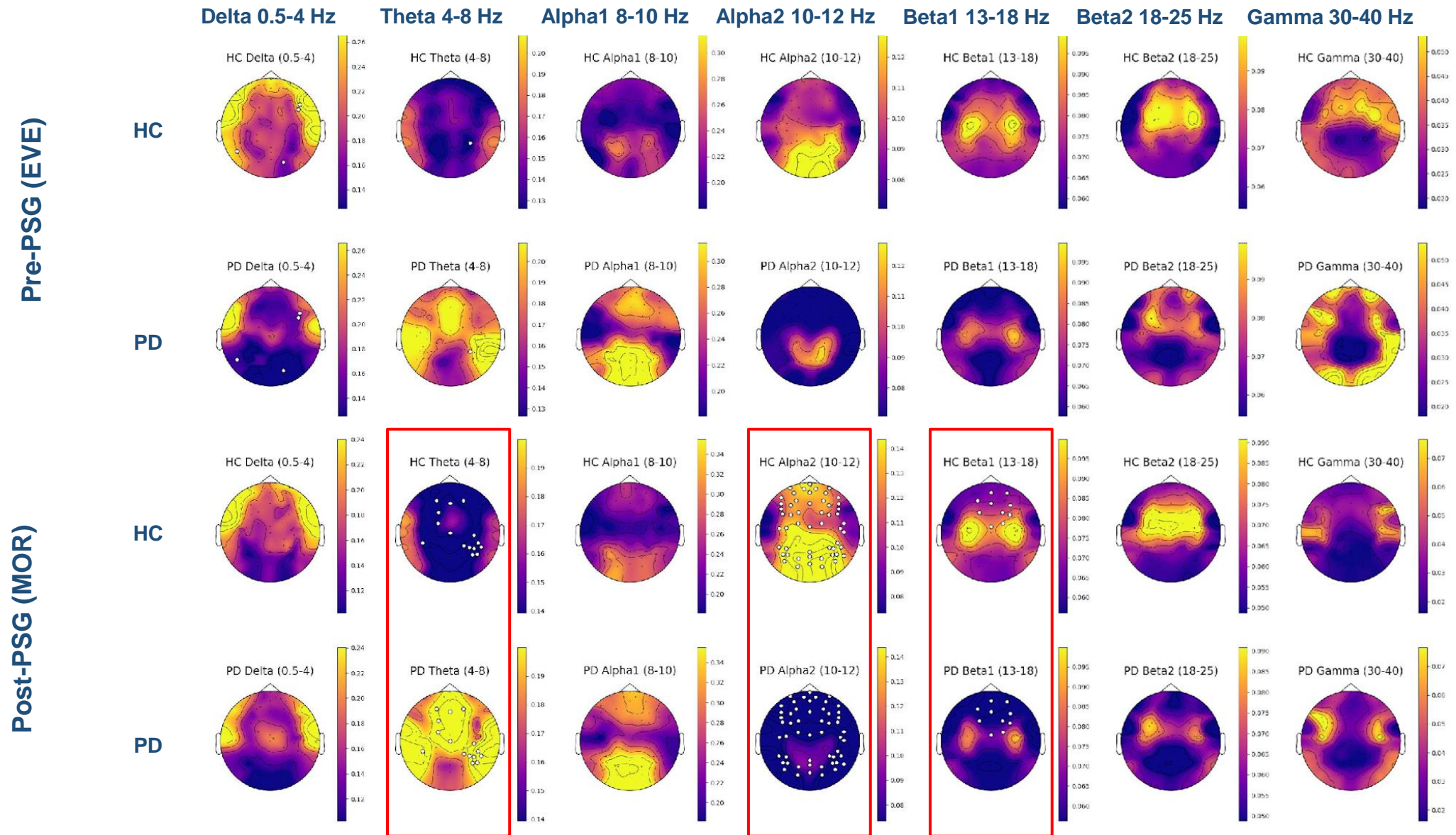
Theta (4-8 Hz)

Alpha1 (8-10 Hz), Alpha2 (10-12 Hz)

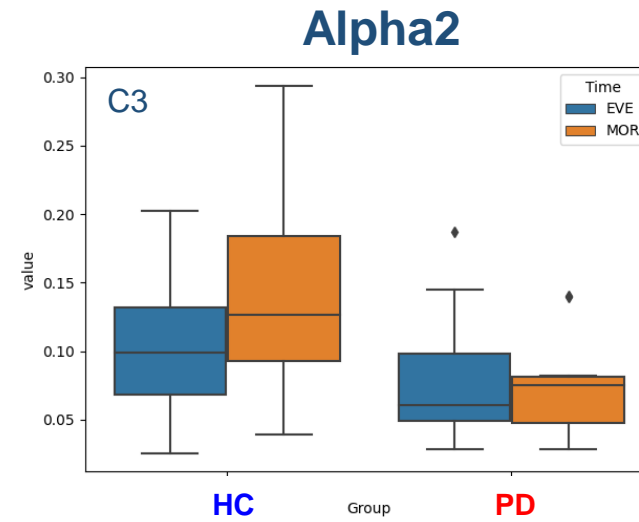
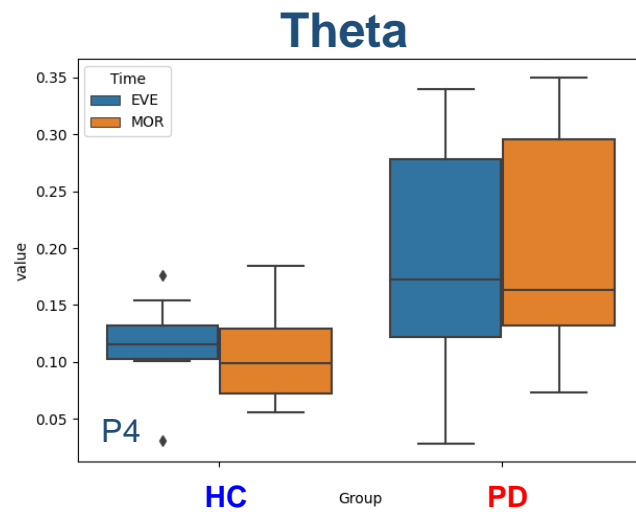
Beta1 (13-18 Hz), Beta2 (18-25 Hz)

Gamma (30-40 Hz)

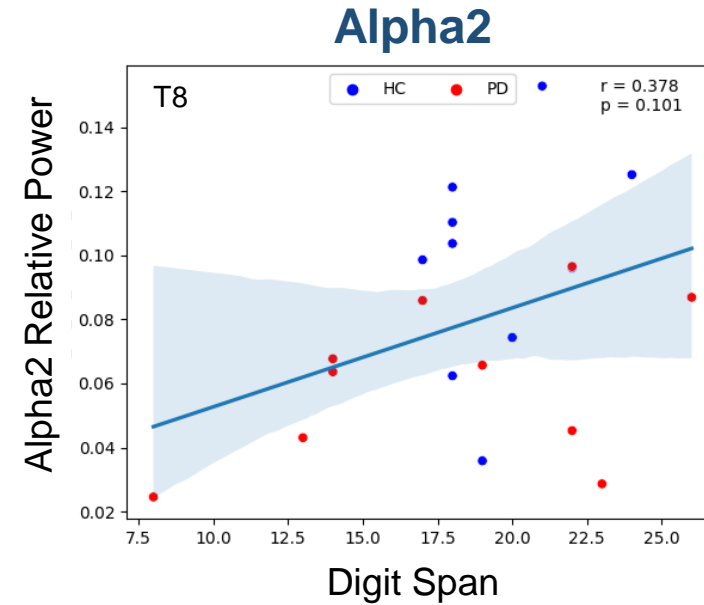
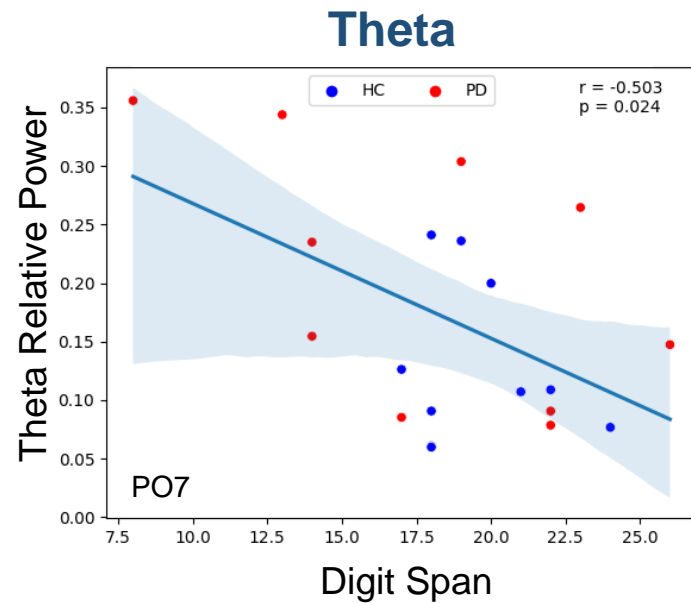
PD vs HC & pre-PSG vs. post-PSG



PD vs. HC pre- vs. post-PSG



rsEEG Correlates with Digit Span Performance

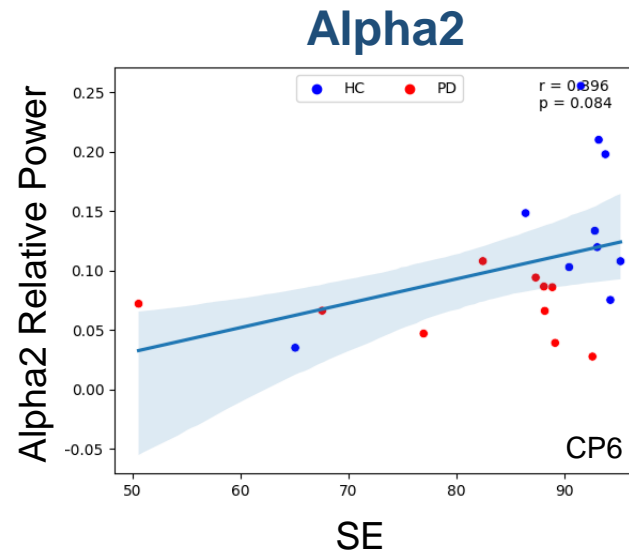
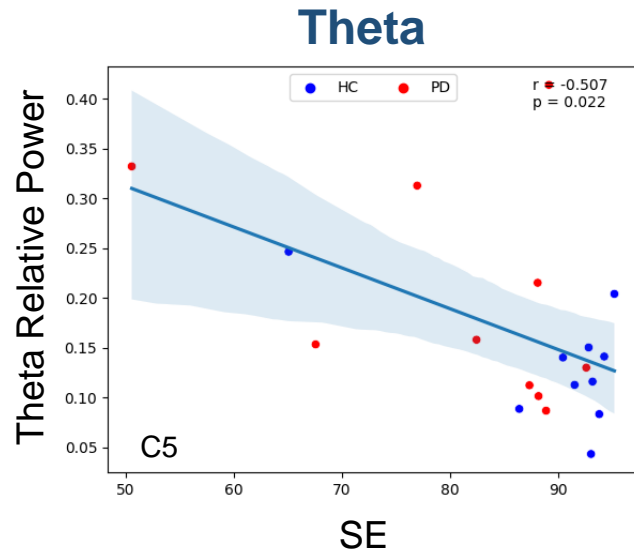


Sleep Measures: PD vs. HC

	PD (N=10)		HC (N=10)		
	Mean	Std.	Mean	Std.	p-val
TIB	471.0	101.18	443.5	76.92	0.503
TST	382.0	105.36	394.8	68.19	0.750
SE	81.2	13.05	89.6	8.96	0.111
SOL	13.2	16.39	14.6	24.58	0.885
WASO	64.2	59.09	28.8	20.05	0.100
N1	8.9	4.85	11.8	10.32	0.426
N2	59.8	15.68	59.7	15.21	0.980
N3	20.3	17.42	19.6	12.01	0.917
REM	11.0	3.92	8.9	3.59	0.235

Data show trends of poorer sleep quality in PD patients relative to HC

rsEEG Correlates with Sleep Efficiency (SE)



Summary

1. Slowing of the resting state EEG in PD
2. Slowing of the resting state EEG reflects cognitive decline
3. Resting state brain activity of HC changes btw pre- and post-sleep; this change is lost in patients.
4. Resting state brain activity while awake affects/reflects sleep quality

Limitations & Future Directions

Limitations:

- Small cohort
- No control yet for confounding factors (OSA)

Next steps:

(after increasing sample)

- Relation to RBD, severity etc.
- Deeper analysis of sleep EEG to understand the underlying cause and effects of wake/sleep states
- rsEEG or differences btw pre- post-sleep as a marker of (early, progression, severity, response etc.)

Thanks

Ofri Levinson

Nir Giladi

Yuval Nir

Riva Tauman

Vladislav Zhelezniakov

Saar Lanir



**The Aufzien Family Center for the Prevention and
Treatment of Parkinson's Disease**
Tel Aviv University

Thank you!

Questions???