Sleep and Neurodegenrative Disorders (SANDS)—Power Spectral Analysis (PSA) study

The broad goals of the SANDS-PSA study are to:

(i) Examine whether differences in sleep microarchitecture (as measured by spectral analysis) have differential effects on specific cognitive domains in PD. For example, delta sleep is considered essential for hippocampal-mediated memory consolidation, and we will examine whether the amount of delta power during different sleep stages affects verbal memory consolidation as measured by post-/pre-sleep memory testing. The relevance of this is that pharmacologic manipulation of sleep microarchitecture has the potential to improve memory, and this study will lay the groundwork for therapeutic interventions to improve memory by treating sleep disorders in PD.

(ii) Examine whether topographical differences in sleep microarchitecture are associated with performances on tasks that measure different cognitive domains. For example, frontal lobe activity mediates working memory and other tasks of executive function. We will analyze whether the amount of slow (or fast) activity in frontal leads is associated with post-/pre- sleep cognitive tests of working memory/executive function

(iii) Subjective sleep (as assessed through questionnaires) and objective sleep (as assessed through sleep microarchitecture) measures are often discordant in the PD population. In other populations, higher frequencies during NREM sleep have been associated with insomnia. We will examine whether there are specific sleep microarchitecture differences between PD patients who report good or bad sleep

(iv) REM sleep behavior disorder (RBD) is characterized by loss of the normal atonia that occurs in REM sleep. While it is established as a motor problem, whether there are electrophysiologic differences during REM sleep in patients with RBD vs. those without is unclear. We will examine the power spectrum across both REM and non-REM sleep in PD patients with vs. without RBD.

The following bands will be defined:

Total (0.5–48 Hz)

Delta (0.5–3.5 Hz)

Theta (3.5–8.0 Hz)

Alpha (8–12.5 Hz)

Sigma (12.5–16 Hz)

Beta1 (16–24 Hz)

Beta2 (24–32 Hz)

Gamma (32–48 Hz)

(Some have log-transformed these values, not sure if we should do this?)

Will want to calculate relative power (band power over/total power across bands) to give the percent of brain activity within a given band

This info will be needed for: (i) night as a whole (ii) REM sleep (iii) NREM sleep separately (also possibly stage 3 vs. stage ½ separately). May also want to compare power in for example first vs. last REM or NREM cycle.

Will want to calculate slow:fast ratio (delta+theta)/(alpha+sigma+beta1+beta2+gamma) for the different portions of sleep and at different electrodes

Will compare hemispheric symmetry and as long as no asymmetry is found in total activity, we will average homologus leads (eg frontal, central, occipital). May also consider conducting analysis just at C3, and/or may also average across all electrodes.

Examples of questions to be examined:

-does the amount of slow:fast activity correlate with delayed recall scores on PVLT (a test of verbal memory)? Hypothesis: positive correlation will be found

-does (difference in post- vs. pre- sleep trails B and digit span backwards) (tests of working memory) correlate with amount of slow activity in frontal leads? (and/or slow:fast ratio)?). Hypothesis: positive correlation will be found

-do patients who complain of subjective sleep quality have greater fast frequencies during NREM sleep than those who report good subjective sleep quality? Hypothesis: positive correlation will be found between fast activity and poor subjective sleep

-what are the differences in power spectra between PD patients with RBD compared to those without? Hypothesis: PD patients with RBD will have greater alpha activity during REM sleep