Insomnia is the most common sleep disorder encountered in clinical practice. Although commonly conceived as a nocturnal disorder it is now considered a 24-hour disturbance as its detrimental consequences extended also during daytime. In particular neurocognitive and mood impairment are frequently reported by insomnia patients [1]. In recent years, a possible relationship between cognitive function, neurophysiological sleep features and outcomes to its most effective treatment, Cognitive-Behavioral Therapy for Insomnia (CBT-I), has been proposed. Particular attention has been paid to the role of specific electroencephalographic (EEG) oscillation, namely sleep spindles, in representing a phenotype able to predict CBT-I outcomes. Sleep spindles are transitory rhythmic brain oscillations between 11 and 15 Hz that constitutes an hallmark of Non-Rapid Eye Movement (NREM) sleep stage 2 and represent the interplay between thalamic nuclei and cortical neurons. Spindle activity is fundamental for several functions such as neuronal development, memory consolidation and the maintenance of sleep continuity. It is influenced by diurnal behavior, since an increased activity following learning task and a positive correlation with post-sleep performance in declarative memory test have been observed [2]. Furthermore, recent literature is focusing on another benchmark of NREM sleep: K-complexes. These high-amplitude graphoelements detectable on fronto-central (EEG) derivation may represent a forerunner of slow wave activity, that is fundamental for the restorative function of sleep and memory consolidation. Rapid Eye Movement (REM) sleep instead is not only fundamental for dreaming function but also for overnight dissipation of emotional distress. Accordingly, a “restless REM sleep”, a state characterized by frequent eye movements and REM sleep arousal, might represent the bridge between insomnia and daytime mood impairment [3]. In the light of this evidence, the aim of this project will be twofold: (1) to identify the neurophysiological phenotype of insomnia disorder that may predict outcomes to CBT-I by analyzing both polysomnographic NREM (sleep spindles, K-complexes and slow wave activity) and REM (eye movements and arousal) features and their relationship to diurnal cognitive performance and mood impairments; (2) to evaluate pre-post CBT-I neurocognitive impairment by means of a comprehensive neuropsychological evaluation and its association with possible polysomnographic changes. A large sample of insomnia patients (50 patients) diagnosed according to the most updated criteria [4] will be prospectively enrolled for this project. Data analysis will be performed throughout both visual scoring of sleep and associated events and ad hoc Matlab script for quantitative EEG analysis. Further analysis will be implemented in SPSS and R. This project will provide an in depth investigation of neurophysiological and cognitive aspects of insomnia and their significance for a timely and efficacious treatment of this disorder that has recently proposed as a modifiable risk factor for the development of neurodegeneration provoked through an inflammatory pathway [5].

The study will take place in three phases in accordance with the duration of the PhD course. During the first year, patients’ enrollment, acquisition of neurophysiological and neuropsychological data as well as planning of data analysis will be conducted by the Phd candidate. During the second year, further patients’ enrollment and analysis of data will be formed. The third year will be fundamental for finalizing data analysis, interpreting results in the light of previous literature and thesis writing.

Our ward and laboratories offer the opportunity to investigate this topic from a multidisciplinary perspective comprising neurophysiological recordings and analyses, neuropsychological assessments and paradigms from experimental psychology.


