

Title: Defining the role of neuromodulatory systems in sleep loss–induced susceptibility to addiction



ERC Field: LS5_2 Molecular and cellular neuroscience; LS5_3 Neurochemistry and neuropharmacology, LS5_8 Behavioral neuroscience; LS5_12 Psychiatric disorders

Key words: Reward and motivation, sleep, synapses, neurocircuitry, electrophysiology, electron microscopy, calcium imaging, optogenetics

Host Institution: University of Camerino

Reference person/supervisor: Luisa de Vivo

luisa.devivo@unicam.it

Research topic description

Sleep disturbances and alcohol use disorder (AUD) exhibit a strong and bidirectional association that contributes to the onset, maintenance, and recurrence of both conditions. While alcohol is commonly used to relieve insomnia and other sleep-related complaints because of its initial sedative effects, prolonged or excessive consumption profoundly disrupts sleep architecture, leading to poorer sleep quality and reduced sleep continuity. In turn, insomnia and other sleep disturbances are highly prevalent in individuals with AUD and frequently persist even after cessation of alcohol use.

Growing evidence indicates that sleep dysfunction is not merely a consequence of alcohol misuse but also a key contributor to craving, increased alcohol intake, and relapse vulnerability during abstinence. Understanding the mechanisms underlying this reciprocal relationship is therefore critical for improving treatment outcomes and preventing relapse in individuals with AUD.

This project aims to define how chronic sleep loss and exposure to alcohol during adolescence affect the maturation and refinement of neuromodulatory circuits that regulate vigilance states and addictive behaviors. Over a three-year period, the researcher will: (1) map the effects of sleep loss and alcohol exposure on noradrenergic, dopaminergic, and orexinergic neurons using histochemical and molecular approaches; and (2) determine the contribution of these neuromodulatory systems in mediating the link between sleep loss and the development of substance use disorders through pharmacological, chemogenetic and optogenetic manipulations.

This research will provide critical insight into the cellular consequences of chronic sleep deprivation and identify biological mechanisms that may drive increased vulnerability to substance use in sleep-deprived individuals.

Research team and environment

The candidate will have the opportunity to learn cutting-edge techniques and to develop their own scientific ideas and ambitions within the context of the research topic. This research project will be carried out in the Brain and Sleep Research Laboratory, Centre for Neuroscience, School of Pharmacy, University of Camerino, Italy. The laboratory led by Luisa de Vivo and Michele Bellesi aims at understanding the functions and mechanisms of sleep in health and disease. Our research combines morphological and functional methods of analysis in both animals and humans to investigate why sleep is beneficial for the brain at the molecular, circuit and behavioral level. On one hand, we are focused on mapping the consequences of sleep impairment across the lifecycle and characterizing the interaction between sleep disruption and other environmental and genetic factors. On the other hand, we are interested in the therapeutic potential of sleep enhancement to improve health and cognition at different levels. To this aim, we are studying pharmacological and non-pharmacological approaches to mitigate neuropsychiatric and neurodegenerative conditions by targeting sleep.

The lab explores also scientific questions linking sleep to glial cells, gut microbiome, cellular metabolism, adipose tissue, torpor, etc., thanks to the collaboration with other research groups within the University of Camerino and outside. Relevant publications, key interests of the research group, and the Laboratory manual can be found at <https://www.bsr-laboratory.org/>. The team consists of several international post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, psychology, informatics, and physics. Researchers have access to 1500 m² of animal facility equipped with systems for EEG/EMG and LFP recordings, in vivo calcium imaging in freely behaving rodents, automatic motion detection, apparatus for behavioral tests, and a new human sleep laboratory. Fully equipped labs for immunohistochemistry, light, confocal, and electron microscopy, cell culture, and molecular biology are available.

Preferred Research Skills and Competences

The doctoral candidate will receive training in animal handling, histology, in vivo and ex vivo imaging, electrophysiology in vivo, behavioural testing, molecular biology, and data analysis. pharmacological, chemogenetic and optogenetic approaches will be also experienced. The ideal candidate has a genuine passion for neuroscience and sleep research, a proactive attitude in studying relevant literature, formulate plausible hypothesis and experiments to test them. Self-motivation, curiosity, and ability to work both alone and in team are essential characteristics. Background in experimental research with rodents, basic knowledge of R, Python or Matlab, and a propensity to care for details are desirable.