Abstract for Oral Presentation

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Student name: Kuan-Lin Chu

Supervisor: Dr. Małgorzata Wrzosek

The Triadic Relationship Between Sleep, the Gut Microbiome, and Cognitive Function: A Critical Review of the Evidence

Emerging evidence supports a complex, multidirectional interplay among sleep, cognitive function, and the gut microbiome, mediated through the brain–gut–microbiome (BGM) axis. This communication network integrates neural, immune, and endocrine signaling pathways—including vagal transmission and microbially derived metabolites—to maintain physiological and cognitive homeostasis. Disruptions in sleep, such as sleep deprivation, circadian misalignment, insomnia, and obstructive sleep apnea (OSA), are increasingly prevalent and are strongly associated with cognitive impairments. However, few studies examine sleep, the gut microbiome, and cognition concurrently, and the mechanistic pathways linking these domains remain incompletely characterized. This presentation shares preliminary insights from an ongoing thesis project—a systematic review of existing literature on sleep physiology, gut microbiome composition, and cognitive outcomes. The work aims to uniquely integrate mechanistic, clinical, and microbiome-specific evidence to outline a conceptual framework for future research.

Preliminary synthesis of the literature indicates that sleep disruption is consistently associated with impairments in cognitive domains such as memory, attention, and executive functioning. Sleep disturbances are also associated with alterations in gut microbiome composition. Reported patterns include reduced microbial diversity, depletion of short-chain fatty acid (SCFA)–producing taxa, and enrichment of opportunistic species, alongside pathological cascades involving neuroinflammation and circadian disruption. Despite growing evidence supporting biological links among sleep, the gut microbiome, and cognitive function, the current literature is limited by substantial methodological heterogeneity, including variability in sleep assessment approaches, microbiome sequencing techniques, cognitive outcome measures, and a predominance of cross-sectional and animal studies. These limitations constrain direct comparison across studies and preclude robust causal inference in humans.

To address these gaps, the present thesis project is advancing toward a systematic review conducted in accordance with PRISMA 2020 guidelines, employing predefined PICOS criteria to rigorously evaluate and synthesize the available evidence. This work aims to clarify mechanistic pathways, identify critical knowledge gaps, and inform future integrative and longitudinal research on sleep–microbiome–brain interactions. Clarifying these pathways may inform microbiome-targeted strategies to mitigate cognitive decline in sleep disorders.