
Integrative Neurophysiology of Stress, Sleep and Cognition Mechanism, Clinical Assessment and Emerging Therapeutics Perspective

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Preface

The human brain is a remarkably complex and adaptable system that continuously integrates internal physiological processes with environmental demands, emotional experiences, behaviour, and cognition. This book has been developed to provide an integrated and contemporary understanding of the dynamic relationships among **stress, sleep, circadian rhythms, cognition, and brain-body regulation**, with particular emphasis on their neurophysiological, clinical, and translational significance. Rather than treating these domains as independent processes, the book presents them as an interconnected biological system in which chronic stress can disturb sleep, inadequate sleep can impair attention, memory, executive functioning, and emotional regulation, and cognitive or emotional dysfunction can further increase vulnerability to stress. The book progresses from fundamental principles of neurophysiology and cognitive neuroscience to the biological clock, circadian organization, neural mechanisms of learning and memory, stress-related dysfunction, and the clinical consequences of disrupted brain-body regulation. Particular emphasis is placed on multimodal clinical and neurophysiological assessment, incorporating clinical evaluation, neuropsychological testing, EEG, polysomnography, actigraphy, neuroimaging, autonomic measures, endocrine and inflammatory biomarkers, and emerging digital phenotyping approaches. The therapeutic perspective emphasizes an integrated, patient-centred approach involving psychological and behavioural interventions, sleep and circadian management, physical activity, nutrition, cognitive rehabilitation, pharmacological treatment, neuromodulation, and multidisciplinary neurorehabilitation. The book further explores emerging developments in wearable technologies, digital biomarkers, artificial intelligence, multimodal data integration, and precision neurophysiology, while recognizing the importance of scientific validation, reproducibility, transparency, privacy, equity, and clinical oversight. By bringing together basic mechanisms, clinical assessment, therapeutic strategies, technological innovation, and future research directions, this book seeks to bridge the gap between fundamental neuroscience and contemporary clinical practice. It is intended to serve as a valuable academic and professional resource for students, researchers, clinicians, educators, and healthcare professionals seeking a deeper understanding of integrated brain function, neural resilience, and personalized approaches to prevention, diagnosis, treatment, and rehabilitation. Ultimately, the book emphasizes that sustainable brain health depends on understanding the continuous interaction among neural networks, biological rhythms, physiological systems, behaviour, environment, and individual experience, thereby providing a foundation for advancing integrative neurophysiology, precision neuroscience, and personalized brain-body medicine.

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