

Preface

Diet, exercise, and sleep play important roles in maintaining good health and longevity. Dietary components not only provide energy and building material to the body, but also have ability to prevent and protect against acute and chronic diseases associated with normal aging and age related diseases. Western diet contains about 50% of total daily calories from refined carbohydrates (cooked rice, pasta, potato, and high fructose corn syrup), 30% calories from fat and refined oils (hydrogenated oils), and 20% from proteins of animal origin (enriched in corn-based livestock). Additionally, Western diet is high in salt, low in fiber and enriched in arachidonic acid (ARA). At present, the ratio of ARA to docosahexaenoic acid (DHA) is about 20:1. In contrast, the Paleolithic diet on which our forefathers lived and survived throughout their history contained high amounts of fresh fruits, green vegetables, lean meats, fish, seeds, piths, and barks with ARA to DHA ratio of 1:1. Long-term consumption of Western diet has been reported to produce detrimental effect on health by inducing an increase in systemic and brain inflammation; stimulating insulin-like growth factor 1 (IGF-1), toll-like receptors, and causing oxidative stress. These processes lead to obesity, diabetes, and metabolic syndrome, which are risk factors for both acute neurological disorders (stroke), chronic age-related neurodegenerative disorders (Alzheimer disease, Parkinson disease, and amyotrophic lateral sclerosis), and neuropsychiatric diseases (depression, anxiety, and schizophrenia). The Mediterranean diet, which is enriched in vegetables, garlic, legumes, fruits, and cereals (largely unrefined); a moderate amounts of fish, high amounts of olive oil; and moderate intake of cheese and yogurt along with modest intake of ethanol, mostly as red wine produces similar effects the Paleolithic diet. In humans, calorie restriction produces beneficial effects through hormesis, a process, which not only inhibits oxidative stress and neuroinflammation through the induction of transcription factors, growth factors, and heat shock proteins, but also promotes neuroplasticity and neurogenesis. Calorie restriction also lowers body temperature, insulin levels, lipids and serum cholesterol not only decreasing the risk of cardiovascular diseases, but also stroke, Alzheimer disease and depression. Conversely, over-nutrition may be a risk factor for age-related disease including obesity, diabetes, heart disease, neurodegeneration, and various types of cancer.

Exercise initiates the maintenance of good cardiorespiratory, cardiovascular, cerebrovascular, and muscular fitnesses by increasing energy consumption, improving insulin sensitivity, increasing blood flow, elevating levels of brain-derived neurotrophic factor, and reducing inflammation. Good nutrition, daily exercise, and adequate sleep are the foundations for maintaining optimal health. Sleep, a complex biobehavioral process, is an essential part of human life. Sleep is not only needed for optimal health and performance, but is beneficial for the formation of memories and sleep deprivation impairs memory processing. Both the cAMP dependent protein kinase (cAMP-PKA) and the extracellular signal-regulated kinase (ERK) pathway critically regulate changes in synaptic efficacy, which is important for memory formation, and crosstalk between both pathways through the exchange protein activated by cAMP (Epac) and Ras plays an important role in memory formation. Because sleep deprivation attenuates hippocampal cAMP levels; therefore, it has been hypothesized that sleep deprivation may indirectly affect the ERK pathway.

Information on diet, exercise, and sleep is scattered throughout the literature in the form of original papers, reviews, and some books. These books describe effects of diet, exercise and sleep on visceral organs. At present there are no books on effects of diet, exercise, and sleep on the brain. The purpose of this monograph is to provide readers with a comprehensive and cutting edge information on the effects of diet, exercise, and sleep on the brain in a manner that is not only useful to students and teachers, but also to researchers, dietitians, nutritionists, exercise physiologists, and physicians.

This monograph has 11 chapters. The first chapter describes the effects of an unhealthy lifestyle on brain metabolism and function. Chapter 2 provides information on the biochemical aspects of neuroinflammation. Chapter 3 deals with the contribution of dietary fat in the induction neuroinflammation. Chapter 4 focuses on cutting edge information on the contribution of genes in the induction of neuroinflammation. Chapter 5 describes the effect of exercise on neuroinflammation in neurological disorders. Chapter 6 narrates the neurochemical aspects of oxidative stress. Chapter 7 describes the cutting edge information on the contribution of dietary fat in the induction of oxidative stress. Chapter 8 provides readers information on the contribution of dietary carbohydrates in the induction of oxidative stress. Chapter 9 deals with cutting edge information on the contribution of genes associated with oxidative stress. Chapter 10 describes the effects of exercise on oxidative stress in neurological disorders. Finally, Chap. 11 deals with the summary, perspective and direction for future studies on the effects of diet, exercise, and sleep on human health.

My presentation and demonstrated ability to present complicated information on signal transduction processes associated with the effects of diet, exercise, and sleep will make this book particularly accessible to neuroscience graduate students, teachers, and fellow researchers. It can be used as a supplemental text for a range of neuroscience, nutrition biochemistry, and exercise physiology courses. Clinicians, neuroscientists, neurologists, dietitians, nutritionists, and exercise physiologists will find this book useful for understanding the molecular aspects of the effects of diet, exercise, and sleep on human health. To the best of my knowledge, this

monograph will be the first to provide a comprehensive description of signal transduction processes associated with the effect of diet, exercise, and sleep on the brain.

The choices of topics presented in this monograph are personal. They are not only based on my interest on the effects of diet, exercise, and sleep on the brain, but also in areas where major progress has been made. Each chapter of this monograph contains a list of references, which are arranged alphabetically to works that are cited in the text. I have tried to ensure uniformity and mode of presentation as well as a logical progression of subjects from one topic to another and have provided an extensive bibliography. For the sake of simplicity and uniformity a large number of figures with chemical structures of dietary components (fatty acids and phytochemicals) along with line diagrams of colored signal transduction pathways are also included. I hope that my attempt to integrate and consolidate the knowledge on the effect of diet, exercise, and sleep will initiate more studies on molecular mechanisms associated with beneficial effects of diet, exercise, and sleep on human health. This knowledge will be useful to the optimal health of young, boomer and pre-boomer American generations.

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