

Contents

1	The Effects of Diet, Exercise, and Sleep on Brain Metabolism and Function	1
1.1	Introduction	1
1.2	Effect of Long-Term Consumption of Western Diet on the Health of Human Brain	3
1.2.1	High Fat Diet and Changes in BDNF Signaling	5
1.2.2	High Fat Diet and Induction of Mitochondrial Abnormalities ...	6
1.2.3	High Fat Diet and Induction of Oxidative Stress and Neuroinflammation	6
1.3	Effect of Mediterranean Diet on Human Brain.....	9
1.4	Effect of Ketogenic Diet on Human Brain.....	12
1.5	Calorie Restriction and its Effects on the Brain.....	15
1.6	Effect of Exercise on Signaling in Visceral Organs	19
1.7	Effect of Exercise on Signaling in the Brain.....	23
1.8	Effect of Sleep on Neuroinflammation	25
1.9	Conclusion.....	28
	References	30
2	Biochemical Aspects of Neuroinflammation.....	43
2.1	Introduction.....	43
2.2	Contribution of Microglial Cells in Neuroinflammation	46
2.3	Contribution of Astrocytes in Neuroinflammation	51
2.4	Differences Between Acute and Chronic Neuroinflammation.....	55
2.5	Markers for Neuroinflammation	57
2.5.1	Cytokines and Chemokines in Neuroinflammation	57
2.5.2	PGs, LTs, TXs, and PAF in Neuroinflammation	58
2.5.3	Interactions Between Neuroinflammation and Excitotoxicity ...	59
2.6	Prevention of Neuroinflammation by n-3 Fatty Acid Metabolites.....	60
2.7	Prevention of Neuroinflammation by Phytochemicals	61
2.8	Prevention of Neuroinflammation by Drugs.....	64
2.9	Conclusion.....	65
	References	66

3	Contribution of Dietary Fat in Neuroinflammation	75
3.1	Introduction	75
3.2	Transport and Incorporation of Fatty Acids in the Brain	77
3.3	Release of ARA and DHA from Neural Membrane Phospholipids	79
3.4	Arachidonic Acid-Derived Lipid Mediators that Support Neuroinflammation	82
3.4.1	Metabolism and Role of Prostaglandins in Neuroinflammation	84
3.4.2	Metabolism and Role of Leukotrienes in Neuroinflammation	87
3.4.3	Metabolism and Role of Thromboxanes in Neuroinflammation	90
3.4.4	Metabolism and Role of Lipoxins in Suppression of Neuroinflammation.....	90
3.4.5	Metabolism and Role of Endocannabinoids in Neuroinflammation	93
3.5	Metabolism and AntiInflammatory Effects of n-3 Fatty Acids in the Brain.....	94
3.5.1	Anti-Neuroinflammatory Effects of Eicosapentaenoic Acid	94
3.5.2	Anti-Neuroinflammatory Effects of Docosahexaenoic Acid.....	96
3.6	Hydroxycholesterols and Neuroinflammation in the Brain	100
3.7	Conclusion.....	101
	References	101
4	Contribution of Receptors, Transcription Factors, and Genes in the Induction of Neuroinflammation	111
4.1	Introduction.....	111
4.2	Contribution of Glutamate Receptors, Toll-like Receptors, and Eicosanoid Receptors in Neuroinflammation.....	114
4.3	Contribution of Transcription Factors in Neuroinflammation	118
4.4	Contribution of Cytokine and Chemokine Receptors in Neuroinflammation	121
4.4.1	Contribution of TNF- α and TNF- α Receptors in Neuroinflammation	122
4.4.2	Contribution of IL-1 α and IL-1 β and Their Receptors in Neuroinflammation.....	124
4.4.3	Contribution of IL-6 and IL-6 Receptors in Neuroinflammation	125
4.4.4	Contribution of IFN γ and INF γ Receptors in Neuroinflammation	126
4.4.5	Contribution of Chemokines and Chemokine Receptors in Neuroinflammation	126
4.5	Regulation of Neuroinflammation by Diet	128

4.6	Modulation of Neuroinflammation by Estrogen	129
4.7	Modulation of Neuroinflammation by Retinoic Acid	131
4.8	Effect of Age on Neuroinflammation.....	132
4.9	Conclusion.....	132
	References	133
5	Effect of Exercise on Neurodegeneration in Neurological Disorders ...	143
5.1	Introduction	143
5.2	Molecular Mechanisms Associated with the Effect of Exercise on the Brain	145
5.3	Molecular Mechanisms Associated with the Effect of Exercise on Neuroinflammation	151
5.4	Exercise-Mediated Neuroprotection in Neurotraumatic, Neurodegenerative, and Neuropsychiatric Diseases	155
5.4.1	Beneficial Effects of Exercise in Seniors	156
5.4.2	Beneficial Effects of Exercise in Stroke Patients.....	157
5.4.3	Beneficial Effects of Exercise on Alzheimer Disease	160
5.4.4	Beneficial Effect of Exercise in Parkinson Disease.....	161
5.4.5	Beneficial Effects of Exercise on Depression.....	163
5.5	Conclusion.....	163
	References	165
6	Neurochemical Aspects of Oxidative and Nitrosative Stress.....	175
6.1	Introduction	175
6.2	Sources Contributing to ROS Production	176
6.3	Phospholipid-Derived Enzymic and Non-Enzymic Biomarkers of Oxidative Stress	183
6.4	Carbohydrate-Derived Biomarkers for Oxidative Stress	187
6.5	Protein-Derived Biomarkers for Oxidative Stress	187
6.6	Nucleic Acid-Derived Biomarkers for Oxidative Stress.....	188
6.7	Neurochemical Aspects of Nitrosative Stress	189
6.7.1	Nitric Oxide and its Effect on Cellular Components	190
6.7.2	Generation of Peroxynitrite and its Effect on Proteins, Lipids and Nucleic Acids	192
6.8	Prevention of Oxidative Stress by Endogenous Mechanisms.....	194
6.9	Prevention of Oxidative Stress by Phytochemicals	195
6.10	Prevention of Oxidative Stress by Antioxidants	196
6.11	Conclusion.....	197
	References	198
7	Contribution of Dietary Fat in the Induction of Oxidative Stress.....	207
7.1	Introduction.....	207
7.2	Effect of Hyperlipidic Diet on Non-Neural Tissues.....	209
7.3	Induction of Nitrosative Stress.....	210

7.4	Neurochemical Effects of Enzymic and Non-Enzymic Lipid Mediators of Arachidonic Acid Metabolism	211
7.4.1	4-Hydroxynonenal and Its Contribution to Oxidative Stress-Mediated Injury	214
7.4.2	Isoprostanes and Their Contribution to Oxidative Stress-Mediated Injury	218
7.4.3	Isoketals and Their Contribution to Oxidative Stress-Mediated Injury	220
7.4.4	Isofurans and Their Contribution to Oxidative Stress-Mediated Injury	222
7.4.5	Acrolein and Its Contribution to Oxidative Stress-Mediated Injury	222
7.4.6	MDA and Its Contribution to Oxidative Stress-Mediated Injury	224
7.5	Prevention of Oxidative Stress by n-3 Fatty Acid-Derived Lipid Mediators in the Brain	225
7.6	Conclusion	227
	References	228
8	Contribution of Dietary Carbohydrates in Induction of Oxidative Stress	237
8.1	Introduction	237
8.2	Differences in Metabolism of Glucose and Fructose in Visceral Tissues	238
8.3	Differences in Metabolism of Glucose and Fructose in the Brain	239
8.4	Induction of Oxidative Stress by High Glucose Consumption	240
8.5	Induction of Oxidative Stress by High Fructose Consumption	247
8.6	Contribution of ROS in Neurodegeneration	250
8.7	Contribution of AGEs in Neurodegeneration	253
8.8	Conclusion	254
	References	255
9	Contribution of Transcription Factors and Genes in the Induction of Oxidative Stress	263
9.1	Introduction	263
9.2	Modulation of Oxidative Stress by Transcription Factors	264
9.2.1	Genes Driven by Transcription Factor, Nrf2	266
9.2.2	Genes Driven by Transcription Factor, AP-1	269
9.2.3	Genes Driven by Transcription Factor NF- κ B	271
9.2.4	Genes Driven by Transcription Factor, FOXO	274
9.2.5	Genes Driven by Hypoxia Inducible Factor-1	274
9.2.6	Genes Associated with Cell Cycle Arrests	275
9.3	Modulation of Oxidative Stress by Vitagenes	276
9.4	Conclusion	279
	References	279

10 Effect of Exercise on Oxidative Stress in Neurological Disorders	287
10.1 Introduction	287
10.2 Involvement of Oxidative Stress in the Pathogenesis of Neurological Disorders	291
10.2.1 Oxidative Stress in Stroke-Mediated Brain Injury	292
10.2.2 Oxidative Stress in Traumatic Brain Injury	293
10.2.3 Oxidative Stress in Spinal Cord Injury	294
10.2.4 Oxidative Stress in Alzheimer Disease	294
10.2.5 Oxidative Stress in Parkinson Disease	295
10.2.6 Oxidative Stress in Amyotrophic Lateral Sclerosis	296
10.3 Relationship Between Exercise and Oxidative Stress	297
10.4 Effect of Exercise, Hormesis, and Other Neurochemical Parameters in the Brain	302
10.5 Effect of Exercise on Neurological Disorders	308
10.5.1 Effect of Exercise in Animal Models of Stroke	309
10.5.2 Effect of Exercise in Animal Models of Alzheimer Disease	310
10.5.3 Effects of Exercise in Animal Models of Parkinson Disease	312
10.5.4 Effect of Exercise on Animal Models of Depression	313
10.5.5 Effect of Exercise on Dementia	314
10.6 Conclusion	316
References	316
11 Summary, Perspective and Direction for Future Studies	329
11.1 Introduction	329
11.2 Effect of Diet on Oxidative Stress	331
11.3 Effect of Diet on Neuroinflammation	334
11.4 Effect of Exercise on Oxidative Stress	335
11.5 Effect of Exercise on Inflammation	336
11.6 Sleep and Induction of Oxidative Stress	337
11.7 Sleep and Induction of Inflammation	339
11.8 Direction for Future Studies on Diet, Exercise, and Sleep	340
11.8.1 Future Studies on Consumption of Diet	341
11.8.2 Future Studies on the Effects of Exercise	341
11.8.3 Future Studies on Molecular Mechanisms of Sleep	342
11.9 Conclusion	343
References	343
Index	351

Inflammation and Oxidative Stress in Neurological
Disorders

Effect of Lifestyle, Genes, and Age

Farooqui, A.A.

2014, XXI, 355 p. 91 illus., 34 illus. in color., Hardcover

ISBN: 978-3-319-04110-0