YOGA FOR CARDIOVASCULAR DISEASE AND REHABILITATION

Integrating Complementary Medicine into Cardiovascular Medicine

Indranill Basu-Ray

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This book is dedicated to the stalwarts who discovered yoga and practiced it to perfection and on whose shoulders we stand today:

Maharishi Patanjali,
Mahavatar Babaji,
Adi Shankaracharya,
Ramakrishna Paramhansa,
Swami Vivekananda,
Syamacharan Lahiri Mahasaya,
Swami Yukeshwar Giri,
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And my beloved Guru.

Swami Hariharananda Giri.

I am also thankful to my family.

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Foreword

Cardiovascular disease remains the largest pandemic, killing both men and women throughout the world. One person dies every 33 s in the United States from cardiovascular disease. About 695,000 people in the United States died from heart disease in 2021—that is one in every five deaths. Cardiovascular disease costs consume an astronomical number of financial resources, including about $239.9 billion annually. While the incidence of cardiovascular disease has plateaued in developed nations, it continues to rise in middle- and low-income countries.

It does not have to be this way.

Inflammation is one of the biological mechanisms that cause cardiovascular disease. There is some evidence that multiple traditional cardiac risk factors, including hypertension, diabetes mellitus, and hyperlipidemia, are all associated with inflammation.

Psychological stress is now considered an independent risk factor for cardiovascular disease. Excessive stress can both initiate and perpetuate cardiovascular disease. Emotional stress induces genetic and endocrinal changes that perpetuate inflammation in blood vessels, leading to heart attack, stroke, or peripheral arterial disease. Furthermore, stress also amplifies sympathetic discharge and attenuates parasympathetic discharge, and this imbalance may cause arrhythmias.

Chronic stress is toxic, generating a cascade of inflammatory cytokines that decrease immunity and generate vascular inflammation. Over time, everyday stresses such as being stuck in traffic, financial pressures, and relationship issues may contribute to chronic inflammation and cardiovascular disease.

Fortunately, stress comes not just from what we do; more important is how we *react* to what we do. By practicing stress management techniques such as yoga and meditation on a regular basis, even a few minutes a day, we can buffer the harmful effects of stress. As a patient once shared with me, "I used to have a short fuse and would explode easily. Now, my fuse is longer. Even if the situation hasn't changed, *I* have."

My colleagues and I conducted randomized controlled trials documenting, for the first time, that a lifestyle medicine intervention including a whole foods plant-based diet low in fat, sugar, and refined carbohydrates, moderate exercise, stress management (including yoga), and social support can often reverse the progression of even severe coronary heart disease, without drugs or surgery.

Over the last few decades, scientific evidence of the many beneficial effects of yoga has been found through genetic, epigenetic, molecular, and cellular studies. While yoga as a series of postures has become popular worldwide, it is important to remember that although all these postures are useful, yoga is much more than a handful of physical exercises. It is, in fact, a cumulative practice of physical exercise, specialized breathing techniques, and mindfulness meditation. It quiets down the mind and body, enabling us to experience an inner sense of peace and well-being that is always there if we just stop disturbing it.

This book presents the clinical and research evidence of yoga's role in cardiovascular diseases as a preventive and therapeutic strategy. It combines decades of research that enables physicians to use yoga as a clinical methodology to treat and prevent many diseases. It also highlights the existing research on the power of yoga and outlines future research strategies to better understand yoga's role. Yoga is freely available, requiring no costly equipment or technology. Patience and practice are the only requirements.

Dr. Indranill Basu-Ray is an eminent Cardiologist and a Cardiac Electrophysiologist at the forefront of yoga research today. He is one of the authors of the American Heart Association's statement on using meditation for cardiovascular risk reduction. He has been practicing yoga, including deep meditation, since age six. Trained by various Himalayan masters, he has been a practitioner of Kriya Yoga. He was initiated into Kriya Yoga by Swami Hariharananda Giri, the brother disciple of Paramhansa Yogananda who wrote the classic book, *Autobiography of a Yogi*.

Dr. Basu-Ray's book is a combined effort of around 40 eminent researchers and clinicians. Every chapter has been compiled with the latest updates included. Thus, this book is a storehouse of information on clinical yoga therapy for clinicians and researchers. Also, every chapter is clinically oriented for healthcare professionals to use in daily clinical

practice. It details the yogic postures used in clinical trials for many different diseases and provides guidelines on prevention and therapeutic use. It also provides recommendations for future research topics that can help move the science of yoga forward.

I commend Dr. Basu-Ray and the coauthors for compiling such a monumental book that brings to light the research on yoga to enable its clinical use. This endeavor will inspire many clinicians to practice yoga therapy as a cost-effective and medically effective modality to treat and prevent cardiovascular diseases.

Dean Ornish, MD

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Preface

After spending over two decades learning, teaching, and mentoring residents and fellows in Medicine and Cardiology, I was always intrigued by the epidemic explosion of cardiovascular disorders worldwide. As medical students, we had patients admitted with heart attacks, predominantly in their 50s and 60s. Contrarily, today, we find that no age is a bar. We have had multiple patients with clinically significant coronary artery disease, even in their 30s. This spurred my interest to go beyond clinical medicine and understand the cause and remedy for such an epidemic. It is undeniable that medicine has made tremendous strides not only in unraveling the pathophysiology of diseases but also in management, with technological advancement occurring almost every day. Despite this, there has been no respite in the evolving heart disease numbers.

I have been a practitioner of Kriya yoga for over three decades now. This robust protocol includes physical exercise, modulated breathing, mindfulness, and meditation. My yoga mentor, Swami Harihārananda Giri, a monk of the Kriya Yoga clan, wanted me to become a cardiologist, understand and explain the mechanism of yoga action scientifically, and spread it to the ordinary person to ensure health and well-being. "Yoga is a potent mechanism to achieve every goal in life, certainly health," he contended. "However, it needs to be understood and spread scientifically." My graduation to be a cardiologist was long and arduous as I had to repeat my training in the United States after being initially trained in India. However, this extended association with learning and research in some of the topmost institutions in the world espoused me to think about the possible reason why even low- and middle-income countries (LMICs) of the world seem to be having a deluge of coronary artery disease. In the United States, nearly one in three ($\sim$80 million) adults have cardiovascular disease (CVD), which imparts a heavy economic burden, including estimated direct costs of approximately $500 billion. It has been projected that by 2035, nearly half of the U.S. population will have some form of cardiovascular disease. Even nations with a younger population, like India, have an explosion of cardiovascular disease in a malignant form that affects much younger population with more severe disease.

My experience and understanding of yoga's essence helped me find an answer. The basic tenets of yoga say that the mind and body are like one entity—they keep each other informed at every second of our existence. Thus, an aberrant mental state garnered by diurnal experience in a world of stress and competitiveness evokes a "flight and fight" reaction, activating genes, hormones, and pathophysiological changes that induce heart diseases. Aberrant lifestyle added to the increased stress of existence as is ostensible today have clubbed together to create a dangerous cascade of heart attacks, heart failure, arrhythmia, and death. Almost half the planet's population suffers from hypertension, a harbinger of other dangerous cardiac diseases. Thus, the cure is only possible if we quieten the mind and douse the inflammatory fire within the body by extinguishing the initial flame initiated inside our brains.

The scientific interrogation of yoga started relatively late in the West but was a welcome change. Funding of such research by the National Institute of Health and the rising popularity of yoga are some of the reasons for this. Many researchers started studying yoga's clinical effects in the last few decades. Numerous leading oncology institutions started implementing yoga protocols as part of their treatment strategies. It is fair to state that oncology led the way to implement yogic therapy in medicine.

Cardiovascular disease remains the largest killer on this planet, killing twice the number of people than cancer. There is robust evidence that multiple cardiac risk factors, including hypertension, diabetes mellitus, and hyperlipidemia, benefit from yoga, including meditation. Stress is now considered the predominant underlying cause of CVD, responsible for the overwhelming majority of mortality on earth. Accumulated evidence in the last decade points to the stress-mediated genetic, epigenetic, and endocrinal changes perpetuating inflammation in blood vessels, leading to heart attack, stroke, or peripheral arterial disease. Yoga has been shown to attenuate many such pathological entities through stress reduction. Aging is a risk factor for aberrant pathophysiological changes leading to increased risk of coronary artery disease and arrhythmias. There is some initial evidence that yoga may help reduce cellular aging. Moreover, it is now established that organ aging, particularly that of the brain, can be decreased by sustained yoga practice. Meditation has been shown to help

the growth of different regions of the cerebral cortex, which now remains firmly substantiated through multiple imaging studies among different cohorts of volunteers. CVD imparts a heavy economic burden on our healthcare system. The CVD costs of care continue to rise, with the current expenses for treatment accounting for nearly $1 of every $6 spent on healthcare. Yoga can help lower this cost through its proven effectiveness in primordial, primary, and secondary prevention.

Yoga for Cardiovascular Disease and Rehabilitation: *Integrating Complementary Medicine into Cardiovascular Medicine* elaborates recent research, clinical trials, and experiments on yoga and meditation as a preventative measure and treatment for various major cardiovascular diseases, including hypertension, hyperlipidemia, coronary artery disease, and metabolic syndromes. It also discusses the current knowledge of yoga's role in ameliorating cardiac dysfunction initiated by emotion and other factors that create and perpetuate vascular inflammation. Cellular, genetic, and molecular effects of yoga based on experimental evidence are also covered in detail, providing readers with the latest research on the impact of yoga and meditation on heart disease. This book also explores current knowledge gaps in yoga research to facilitate further research. It is a comprehensive reference to physicians, scientists, and clinicians interested in understanding yoga's role in preventing and treating cardiovascular diseases. This book adopts a translational approach, exploring yoga's clinical, cellular, genetic, and molecular effects on health based on the latest research evidence.

This book would never have seen the light of day without the belief and support of my acquisition editor, Stacy Masucci, who believed in me and the power of yoga as a potent healing entity. I also remain thankful to the Elsevier team, including Ana Garcia and Tracy Lange, for contributing to this project. I remain immensely grateful to Ms. Kristi Anderson and Ms. Billie Jean Fernandez, my editorial project managers, whose astute working ethics and friendly ambiance helped me throughout the long and arduous process of writing the book. I am grateful to all the authors who collaborated with me to create this unique work. Most of them are busy clinicians and researchers with extensive experience in both clinical medicine and yoga. I am also thankful to my postdoctorate research scholars, led by Dr. Sukhendu Mandal, Dr. Inbaraj G and Dr. Manjot Singh, and my doctoral research volunteer, Ms. Khusboo Arya, and my graduate research scholars, led by Reetoban Dutta, including Oishi Roy Choudhury, Nandita Bhalla, Nemalidinne Krishna Vani, Abinay Siva Kumar Reddy, and Mridul Sarangal, without whose dedication and hard work it would have been impossible for me to complete this substantial undertaking.

I am finally thankful to my wife Julie and my son Ishan, who had to put up with my being busy with this project evening after evening for over a year that I could have spent with them. Without their substantial help and sacrifice, this project would have never seen completion.

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Abbreviations

18F-FDG	18F-fluorodeoxyglucose
5HT	5-hydroxytryptamine
AA	African American
AACE	American Association of Clinical Endocrinologists
AACPR	American Association of Cardiovascular and Pulmonary Rehabilitation
AADs	Antiarrhythmic Drugs
ABPM	Ambulatory Blood Pressure Monitoring
ACC	American College of Cardiology
ACC/AHA	American College of Cardiology/American Heart Association
ACCF	American College of Cardiology Foundation
ACE	Angiotensin-Converting Enzyme
ACEI	Angiotensin Converting Enzyme Inhibitor
ACPA	Anti−Citrullinated Protein Antibody
ACS	Acute Coronary Syndrome
ACTH	Adrenocorticotrophic Hormone
AD	Alzheimer's Disease
ADA	American Diabetes Association
ADAS	Alzheimer's Disease Assessment Scale
ADM	Adrenomedullin
ADMA	Asymmetric Dimethylarginine
AEs	Adverse Events
AEBs	Abnormal Eating Behaviors
AF	Atrial Fibrillation
AFR	Africa Region
AG	Acylated Ghrelin
AGB	Adjustable Gastric Band
AGi	Alpha-Glucosidase Inhibitor
AHA	American Heart Association
AHD	Atherosclerotic Heart Disease
AI	Aortic Insufficiency
AIR	Acute phase Insulin Release
AMI	Acute Myocardial Infarction
AMPK	AMP-activated Protein Kinase
ANB	Alternate Nostril Breathing
ANG	Angiogenin
ANS	Autonomic Nervous System
ANT	Attentional Network Task
ApoAII	Apolipoprotein A II
AR	Aortic Regurgitation
ARBs	Angiotensin II Receptor Blockers
ARC	Hypothalamic Arcuate Nucleus
ARIC	Atherosclerosis Risk in Communities
ARNI	Angiotensin Receptor blockade with Neprilysin Inhibition
AS	Ankylosing Spondylitis
AS	Aortic Stenosis
ASCVD	Atherosclerotic Cardiovascular Disease

ASL	Arterial Spin Labeling
ASPC	American Society for Preventive Cardiology
ATP III	Adult Treatment Panel III
AUDIT	Alcohol Use Disorder Identification Test
AV	Atrioventricular
AVN	Atrio-ventricular Node
AVR	Aortic Valve Replacement
AY	Ananda Marga Yoga
AYUSH	Ayurveda, Yoga, Unani, Siddha, Homeopathy
BA	Breathing Awareness
BBS	Berg Balance Scale
BDI-II	Beck Depression Inventory-II scale
BDNF	Brain-Derived Neurotrophic Factor
BDNP	Brain-derived Natriuretic Peptide
BE	Energy Balance
BER	Base Excision Repair
BF%	Body Fat Percentage
BFM	Body Fat Mass
BIA	Bioelectrical Impedance
BMI	Body Mass Index
BNP	Brain Natriuretic Peptide
BP	Blood Pressure
BPD	Biliopancreatic Diversion
BPD/DS	Biliopancreatic Diversion with Duodenal Switch
BPM	Beats Per Minute
BSX	Brain-Specific Homeobox Domain
BW	Body Weight
CABG	Coronary Artery Bypass Grafting
CAD	Coronary Artery Disease
CAG	Coronary Angiography
CAM	Complementary and Alternate Medicine
CaMKK2	Calcium/Calmodulin-dependent Protein Kinase Kinase 2
CBF	Cerebral Blood Flow
CDC	US Centers for Disease Control and Prevention
CDS	Cardiac Depression Scale
CFR	Coronary Flow Reserve
CG	Control Group
CGI-S	Clinical Global Impression Severity
CHD	Coronary Heart Disease
CHF	Congestive Heart Failure
CI	Confidence Interval
CIA	Chronic Inflammatory Arthritis
cIMT	Carotid Intimal Thickness
CKD	Chronic Kidney Disease
CM	Control Meditation
CMP	Cardiomyopathy
CNP	Chandra Nadi Pranayama
CNS	Central Nervous System
CO	Canola Oil
CO	Cardiac Output
COPD	Chronic Obstructive Pulmonary Disease
COWS	Clinical Opiate Withdrawal Scale
COX-2	Cyclooxygenase 2
CPGs	Clinical Practice Guidelines
CPT	Carnitine Palmitoyltransferase
CR	Cardiac Rehabilitation
CRA	Comparative Risk Assessment
CREB	cAMP Response Element-Binding Protein

CRF	Cardiorespiratory Fitness
CRF	Corticotrophin-Releasing Factor
CRH	Corticotrophin-Releasing Hormone
CRP	C-Reactive Protein
CRT	Cardiac Resynchronization Therapy
CRT-D	Cardiac Resynchronization Therapy with Defibrillator
CS	Coronary Sinus
CSA	Chronic Stable Angina
CSD	Cardiac Sympathetic Denervation
CSF	Cerebral Spinal Fluid
CSMMU	Chhatrapati Shahuji Maharaj Medical University (Formerly King George's Medical University)
CSP	Cortical Silent Period
CT	Computed Tomography
CT CAG	Computed Tomography Coronary Angiography
CT-FFR	Computed Tomography−derived Fractional Flow Reserve
CTLA4	Cytotoxic T-Lymphocyte-Associated protein 4
CTRA	Conserved Transcriptional Response to Adversity
CUD	Cannabis Use Disorder
CUD	Cocaine Use Disorder
CV	Cardiovascular
CVA	Cerebrovascular Accident
CVC	Comprehensive Valve Center
CVD	Cardiovascular Disease
CVEs	Cardiac Vascular Events
CVH	Cardiovascular Health
CVPR	Cardiovascular and Pulmonary Rehabilitation
CVRFs	Cardiovascular Risk Factors
CYP	Common Yoga Protocol
D-MARDs	Disease-Modifying Anti-Rheumatic Drugs
D-TGAs	D-Transposition of Great Arteries
DAG	Directed Acyclic Graph
DALY	Disability Adjusted Life-Years
DAMP	Damage-Associated Molecular Patterns
DAN	Dorsal Attention Network
DASH	Dietary Approaches to Stop Hypertension
DASI	Duke Activity Status Scale
DASS-21	Depression Anxiety Stress Scale
DAYS	Diabetes and Yoga Study
DBP	Diastolic Blood Pressure
DC	Direct Cardioversion
DHA	Docosahexaenoic Acid
DHEAS	Dehydroepiandrosterone Sulfate
DLCO	Diffusion Capacity of the Lungs for Carbon Monoxide
DLPFC	Dorsolateral Prefrontal Cortex
DM	Diabetes Mellitus
DM	Type II Diabetes Mellitus
DMN	Default Mode Network
DNA	Deoxyribonucleic Acid
Do-P	Double Product
DPP	Diabetes Prevention Program
DPP-4i	Dipeptidyl Peptidase-4 Inhibitor
DPPOS	U.S. Diabetes Prevention Program Outcomes Study
DPS	Diabetes Prevention Study
DREAM	Diabetes REduction Approaches with ramipril and rosiglitazone Medications
DSM-5	Diagnostic and Statistical Manual-5
DSM-IV	Diagnostic and Statistical Manual-IV
DTV	Device-Treated Ventricular Events

DUDIT	Drug Use Disorders Identification Test
DVD	Double Vessel Disease
DYS	Diabetes Yoga Protocol
EASD	European Association for the Study of Diabetes
EC SOD	Extracellular Superoxide Dismutase
ECG	Electrocardiography
ECN	Executive Control Network
EDs	Eating Disorders
EDD	End Diastolic Dimension
EEG	Electroencephalography
EGIR	European Group for the study of Insulin Resistance
EKG	Electrocardiography
ELR	External Loop Recorder
EMG	Electromyography
EMS	Emergency Medical Services
ENDS	Electronic Nicotine Delivery Systems
ENNDS	Electronic Non-Nicotine Delivery Systems
EPs	Evoked Potentials
EPA	Eicosapentaenoic Acid
EPIC	European Prospective Investigation into Cancer and Nutrition
EPS	Electrophysiological Studies
EQ-QOL	European Quality of Life
ERO	Effective Regurgitant Orifice
ERPs	Event-Related Potentials
ES	Eisenmenger Syndrome
ESC	European Society of Cardiology
ESC/EAS	European Society of Cardiology/European Atherosclerosis Society
ESC/ESH	European Society of Cardiology and European Society of Hypertension
ESD	End Systolic Dimension
ESR	Erythrocyte Sedimentation Rate
EULAR	European League Against Rheumatism
FA	Fatty Acid
FB	Fast Breathing
FBG	Fasting Blood Glucose
FBS	Fasting Blood Sugar
FDA	Food and Drug Administration
FDS	Forward Digit Span
FEC	Functional Exercise Capacity
FFA	Free Fatty Acid
FH	Familial Hyperlipidemia
FMC	First Medical Contact
fMRI	Functional Magnetic Resonance Imaging
FOXO1	Forkhead Box 1
FRS	Framingham Risk Score
FS	Flourishing Scale
FVC	Forced Vital Capacity
GABA	Gamma-amino Butyric Acid
GAD	Generalized Anxiety Disorder
GBD	Global Burden of Disease
GCs	Glucocorticoids
GDM	Gestational Diabetes Mellitus
GDMT	Guideline-Directed Medical Therapy
GDS15	Geriatric Depression Scale-15
GH	Growth Hormone
GHDx	Global Health Data Exchange
GI	Glycemic Index
GL	Glycemic Load
GLN	Glinide

GLP-1 RA	Glucagon-like Peptide-1 Receptor Agonist
GM	Gray Matter
GMV	Gray Matter Volume
GP	Ganglionated Plexus
GPCR	G-protein-Coupled Receptor
GR	Glutathione Reductase
GSH	Glutathione
GST	Glutathione S-transferase
GXT	Graded Exercise Test
HAM-A	Hamilton Anxiety Rating Scale
HAM-D	Hamilton's Depression Rating Scale
HAQ-DI	Health Assessment Questionnaire Disability Index
HbA1c	Glycosylated Hemoglobin
Hbdiff	Hemoglobin difference
HC	Hip Circumference
HDAC	Histone Deacetylase
HDL	High-Density Lipoprotein
HF	Heart Failure
HFimpEF	Heart Failure with Improved Ejection Fraction
HFmrEF	Heart Failure with Mildly Reduced Ejection Fraction
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HGP	Hepatic Glucose Production
HIV	Human Immunodeficiency Virus
HLA-B27	Human Leukocyte AntigenB27
HMGCoA	Hydroxymethylglutaryl-coenzyme A
HMPAO	Hexamethylpropyleneamine Oxime
HOMA-IR	Homeostatic Model Assessment for Insulin Resistance
HPA	Hypothalamic Pituitary Adrenal Axis
HR	Hazard Ratio
HR	Heart Rate
HR-QoL	Health-Related Quality of Life
HRV	Heart Rate Variability
hs-CRP	Highly Sensitive C Reactive Protein
HsTnI	Highly Sensitive Troponin I
HTN	Hypertension
HTP	Heated Tobacco Product
HY	Hathayoga
I/G Ratio	Insulin/Glucagon Ratio
IAS	Interatrial Septum
ICD	International Classification of Diseases
ICD	Implantable Cardioverter Defibrillator
ICD-10	International Classification of Diseases, 10th Revision
ICMR-INDIAB	Indian Council of Medical Research-India Diabetes
ICPPR	International Council of Cardiovascular Prevention and Rehabilitation
IDF	International Diabetes Federation
IDL	Intermediate Density Lipoprotein
IFG	Impaired Fasting Glucose
IFN	Interferon
IGT	Impaired Glucose Intolerance
IHD	Ischemic Heart Disease
IKK	Inhibitor of Nuclear Factor-κB Kinase
IL	Interleukin
IL-6	Interleukin-6
ILR	Implantable Loop Recorder
IMT	Intima-Media Thickness
INR	Indian Rupee

IR	Insulin Resistance
IRF	Interferon Regulatory Factor
IRFs	Interferon Response Factors
ISH	International Society of Hypertension
IV	Inverse Variance
IV	Intravenous
IVC	Inferior Vena Cava
IVS	Interventricular Septum
JD	Japan Diet
K10	Kessler Psychological Distress Scale
KKM	Kirtan Kriya Meditation
KOR	Kappa Opioid Receptor
LA	Linolenic Acid
LCDs	Low-Calorie Diets
LCT	Letter Cancellation Test
LDL	Low Density Lipoprotein
LDL-C	Low Density Lipoprotein Cholesterol
LF/HF Ratio	Low Frequency/High Frequency Ratio
LHPA	Limbic Hypothalamic Pituitary Adrenal Axis
LNB	Left Nostril Breathing
Low−MEE	Low Myocardial Mechano-Energetic Efficiency
LPFC	Left Prefrontal Cortex
LPS	Lipopolysaccharide
LV and RV	Left Ventricle and Right Ventricle
LV	Left Ventricle
LVAD	Left Ventricular Assist Device
LVEDP	Left Ventricular End Diastolic Pressure
LVEDV	Left Ventricular End Diastolic Volume
LVEF	Left Ventricular Ejection Fraction
LVH	Left Ventricular Hypertrophy
MACEs	Major Adverse Cardiac Events
MAP	Mean Arterial Blood Pressure
MASALA	Mediators of Atherosclerosis in South Asians Living in America
MB	Moderator Band
MBIs	Mind Body Interventions
MBSR	Mindfulness-Based Stress Reduction
MBTs	Mind Body Therapies
MC3R	Melanocortin Receptor 3
MCP-1	Monocyte Chemotactic Protein−1
MCS	Mechanical Circulatory Support
MDA	Malondialdehyde
MDD	Major Depressive Disorder
MDMA	3, 4-Methylenedioxymethamphetamine
MEG	Magnetoencephalography
MET	Metabolic Equivalents
MET	Metformin
Meth	Methamphetamine
MetS	Metabolic Syndrome
MI	Myoinositol
MI	Myocardial Infarction
MINOCA	Myocardial Infarction with Nonobstructive Coronary Arteries
MLwHFQ	Minnesota Living with Heart Failure Questionnaire
MM	Mindfulness Meditation
MnSOD	Manganese Superoxide Dismutase
MnSOR	Methionine Sulfoxide Reductase
MNT	Medical Nutrition Therapy
MONICA	Monitoring of Trends and Determinants in Cardiovascular Disease
MRC	Medical Research Council of Great Britain

MRI	Magnetic Resonance Imaging
MRS	Magnetic Resonance Spectroscopy
MS	Mitral Stenosis
MSU	Monosodium Urate
MT	Medical therapy
mtDNA	Mitochondrial DNA
mTOR	Mammalian Target of Rapamycin
MUFA	Mono Unsaturated Fatty Acid
MV	Mitral Valve
MVA	Mitral Valve Area
MVR	Mitral Valve Replacement
NA	Not Available
NAA	N-acetyl aspartate
NAD	Nicotinamide Adenine Dinucleotide
NAVIGATOR	Nateglinide and Valsartan in Impaired Glucose Tolerance Outcomes Research
NCCIH	National Center for Complementary and Integrated Health
NCD	Non-Communicable Disease
NCEP	National Cholesterol Education Program
NCEP:ATP III	National Cholesterol Education Program Adult Treatment Panel III
NCHS	National Center for Health Statistics
NCS	Nerve Conduction Studies
NE	Norepinephrine
NET	Neutrophil Extracellular Trap
NF-kB	Nuclear Factor Kappa B
NFHS-3	National Family Health Survey-3
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NICE	National Institute for Health and Care Excellence
NIDDM	Non-Insulin−Dependent Diabetes Mellitus
NMA	Network Meta-Analysis
NO	Nitric Oxide
NOS	Nitric Oxide Synthetase
NPY/AgRP	Neuropeptide Y/Agouti-Related Peptide
NS	Nervous System
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
NSTEMI	Non-ST-segment Elevation Myocardial Infarction
NTProBNP	N-terminal Pro B-type Natriuretic Peptide
NYHA	New York Heart Association
ODS	Opioid Dependence
OGTT	Oral Glucose Tolerance Test
OHQ	Oxford Happiness Questionnaire
OO	Olive Oil
OS	Oxidative Stress
OSA	Obstructive Sleep Apnea
OUDs	Opioid Use Disorders
OXPHOS	Oxidative Phosphorylation
p-mTOR	Phosphorylated Mammalian Target of Rapamycin
PA	Physical Activity
PA	Pulmonary Artery
PAD	Peripheral Artery Disease
PAF	Paroxysmal Atrial Fibrillation
PAMPK	Phosphorylated AMP-Activated Protein Kinase
PANAS	Positive and Negative Affect Scale
PASP	Pulmonary Artery Systolic Pressure
PAX	Parasternal Long Axis view
PBMC	Peripheral Blood Mononuclear Cell
PCI	Percutaneous Intervention

PCOS	Polycystic Ovarian Syndrome
PD	Panic Disorder
PD	Parkinson's Disease
PE	Pulmonary Embolism
PET	Positron Emission Tomography
PFC	Prefrontal Cortex
PFT	Pulmonary Function Test
PGC1α	Peroxisome Proliferator-Activated Receptor-γ Coactivator
PHP	Personalized Health Planning
PHT	Pressure Half Time
PISA	Proximal Hypovelocity Hemispheric Surface Area
PM	Progressive Relaxation Meditation
PMBC	Percutaneous Mitral Balloon Commissurotomy
PNMT	Phenylethanolamine N-methyltransferase
PNS	Parasympathetic Nervous System
POTS	Postural Tachycardia Syndrome
PPARγ	Peroxisome Proliferator-Activated Receptor-Gamma
PPBG	Postprandial Blood Glucose
PPBS	Postprandial Blood Sugar
PPI	Permanent Pacemaker Implantation
PROBE	Prospective Randomized Open Blinded End-Point
PROMs	Patient-Related Outcome Measures
PsA	Psoriatic Arthritis
PsO	Psoriasis
PTCA	Percutaneous Transluminal Coronary Angioplasty
PTSD	Post-Traumatic Stress Disorder
PUFA	Poly Unsaturated Fatty Acid
PURE	Prospective Urban and Rural Epidemiological Study
PVs	Pulmonary Veins
PVCs	Premature Ventricular Contractions
QoL	Quality of Life
QR	Quick Release
QTd	QT Dispersion
RA	Rheumatoid Arthritis
RAAS	Renin−Angiotensin−Aldosterone System
RAS	Renin−Angiotensin System
RBO	Rice Bran Oil
rCBF	Regional Cerebral Blood Flow
rCMRGlc	Regional Cerebral Metabolic Rate of Glucose Consumption
RCT	Randomized Controlled Trial
RDS	Reverse Digit Span Test
RES	Restorative Hatha Yoga
RF	Rheumatoid Factor
RF	Regurgitant Fraction
RFA	Radio Frequency Ablation
RFFT	Ruff Figural Fluency Test
RM	Rajyoga Meditation
RM	Relaxing Music
RMSSD	Root Mean Square of Successive Differences between normal heartbeats
RNB	Right Nostril Breathing
RNS	Reactive Nitrogen Species
ROI	Region of Interest
ROM	Range of Motion
ROS	Reactive Oxygen Species
RPFC	Right Prefrontal Cortex
RPP	Rate Pressure Product
RSNs	Resting-State Networks
RSPV	Right Superior Pulmonary Vein
RVol	Regurgitant Volume
RYGB	Roux-en-Y Gastric Bypass
S/P	Status Post

SAEs	Serious Adverse Events
SAN	Sino-atrial Node
SAT	Scholastic Assessment Test
SAX	Parasternal Short Axis view
SB	Slow Breathing
SBP	Systolic Blood Pressure
SBWI	Standard Behavioral Weight-loss Intervention
SCD	Sudden Cardiac Death
SD	Standard Deviation
SDNNi	Standard Deviation of NN intervals Index
SEAR	South East Asian Region
SES	Social Economic Status
SF12	Short-Form Health Survey
SFA	Saturated Fatty Acid
SGLT2i	Sodium-Glucose Transporter 2 Inhibitor
sHLA-G	Soluble Human Leukocyte Antigen
SICI	Short Intra-Cortical Inhibition
SIHD	Stable Ischemic Heart Disease
SIRT1	Sirtuin1
SKY	Sudarshan Kriya Yoga
SMART	Specific, Measurable, Achievable, Realistic, Time-limited
SMC	Smooth Muscle Cell
SNS	Sympathetic Nervous System
SNS-HPA	Sympathetic Nervous System−Hypothalamic Pituitary Adrenal Axis
SOD	Superoxide Dismutase
SpAs	Spondyloarthritides
SPANE	Scale of Positive and Negative Experience
SPECT	Single Photon Emission Computed Tomography
SR	Systematic Review
SSRI	Selective Serotonin Reuptake Inhibitors
STAI	State-Trait Anxiety Inventory
STEMI	ST Elevation Myocardial Infarction
STS	Society of Thoracic Surgeons
SU	Sulfonylurea
SUD	Stimulant Use Disorder
SVC	Slow Vital Capacity
SVC	Superior Vena Cava
SVT	Supraventricular Tachycardia
SY	Sahaja Yoga
T2DM	Type 2 Diabetes Mellitus
ta-VNS	Transcutaneous Auricular Vagal Nerve Stimulation
TAC	Total Antioxidant Capacity
TAK1	Transforming growth factor-β-activated kinase 1
TAS	Total Anti-Oxidant Stress
TAVI	Transcatheter Aortic Valve Implantation
TBs	Tibetan Buddhists
TB	Tuberculosis
TC	Total Cholesterol
TCIM	Traditional, Complementary, and Integrative Medicine
tDCS	Transcranial Direct Current Stimulation
TdP	Torsades de Pointes
TEE	Total Energy Expenditure
TEI	Total Energy Intake
TF	Transfemoral
TGs	Triglycerides
TGF-β	Transforming Growth Factor β
TLCs	Therapeutic Lifestyle Changes
TLR9	Toll-Like Receptor 9
TM	Transcendental Meditation
TMA	Trimethylamine

TMAO	Trimethylamine Oxidase
TMS	Transcranial Magnetic Stimulation
TNF	Tumor Necrosis Factor
TNF-a	Tumor Necrosis Factor-a
TOF	Tetralogy of Fallot
TOS	The Obesity Society
TPM	Temporary Pacing
TPR	Total Peripheral Resistance
TRAF6	TNF Receptor-Associated Factor 6
TrkB	Tropomyosin Receptor Kinase B
TSH	Thyroid Stimulating Hormone
TTA	Trail making Test 'A'
TTB	Trail making Test 'B'
TVD	Triple Vessel Disease
TZD	Thiazolidinedione
UA	Unstable Angina
UCP2	Uncoupling Protein 2
UK	United Kingdom
UNB	Unilateral Nostril Breathing
UNDOC	United Nation Office on Drugs and Crime
UPRmt	Mitochondrial Unfolded Protein Response
USA	United States of America
VaD	Vascular Disease
VAS	Visual Analogue Scale
VBCT	Voxel-Based Cortical Thickness
VC	Vena Contracta
VEGF	Vascular Endothelial Growth Factor
VF	Ventricular Fibrillation
VHD	Valvular Heart Disease
VIN	Vinyasa Yoga
VKA	Vitamin K Antagonist
VLCDs	Very-Low Calorie Diets
VLDL	Very Low Density Lipoprotein
VMH	Hypothalamic Ventromedial Nucleus
VNS	Vagal Nerve Stimulation
VT	Ventricular Tachycardia
VVS	Vasovagal Syncope
WAIS−RNI	Wechsler Adult Intelligence Scale−Revised Neuropsychological Instrument
WC	Waist Circumference
WHO	World Health Organization
WHOQOL-BREF	World Health Organization Quality of Life Scale—short version
WHR	Waist to Hip Ratio
WHYES	Women's Health, Yoga and Education Study
YB	Yoga Breathing
YG	Yoga Group
YLD	Years Lived with Disability
YLL	Years of Lives Lost
YLP	Yoga-Based Lifestyle Protocol
Yoga-CaRe	Yoga-based Cardiac Rehabilitation
YOMI	Yin yoga + psychoeducation and mindfulness practice
YPA Scale	Yoga Performance Assessment Scale
YT	Yoga Treatment
γ-BB	γ-Butyrobetaine

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YOGA FOR CARDIOVASCULAR DISEASE AND REHABILITATION

Integrating Complementary Medicine into Cardiovascular Medicine

Indranill Basu-Ray

Yoga in Cardiovascular Disease and Rehabilitation highlights the recent research, clinical trials, and experiments on yoga and meditation as a preventative and therapeutic measure against various major cardiovascular diseases, including hypertension, hyperlipidemia, coronary artery disease, stroke, vascular dementia, and metabolic syndromes, including Diabetes Mellitus.

Cardiovascular Disease remains the largest killer on the planet. It continues to show an alarming increasing trend in most economies. Chapters discuss yoga's role in ameliorating cardiac dysfunction and the current knowledge about the effects of yoga on the brain, emotion, and vascular factors that initiate and perpetuate vascular inflammation, leading to cardiovascular mortality and morbidity. Cellular, genetic, and molecular effects of yoga based on experimental evidence are also covered in detail, providing readers with the latest research on the effects of yoga and meditation on heart diseases. The mechanism of yoga's action on the autonomic nervous system has been elucidated, explaining its role in many cardiovascular conditions, including heart failure and arrhythmias.

This book also explores current knowledge gaps in yoga research to facilitate further research and is a comprehensive reference to scientists and clinicians who are interested in yoga's health effects, including preventing and treating diseases.

It is a must-read for clinicians from those in family practice to cardiologists as most likely their patients and/or their kin either know or practice yoga, given the over 300 million yoga practitioners worldwide. It is certainly an affordable alternative in many situations, given the accelerating cost of modern medicine.

Key Features

- Highlights all the important historical and current research, clinical trials, and experiments on yoga and meditation- as a preventative and therapeutic entity against various cardiovascular problems
- Covers all major heart diseases, including hypertension, hyperlipidemia, coronary artery disease, heart failure, stroke, diabetes mellitus, arrhythmias, and more
- Concepts with extensive illustrations and references for better understanding and clinical and research implementation
- Extensively illustrated with figures, tables, and clinical pathways to elucidate yoga's application in daily clinical practice
- Details yogic postures used in clinical trials to be used for prescribing yoga in different cardiovascular diseases

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