THE PRINCIPLES AND PRACTICE OF YOGA IN HEALTH CARE

Sat Bir Singh Khalsa • Lorenzo Cohen
Timothy McCall • Shirley Telles

Forewords by
Dean Ornish, MD • Belle Monappa Hegde, MD, PhD, FRCP

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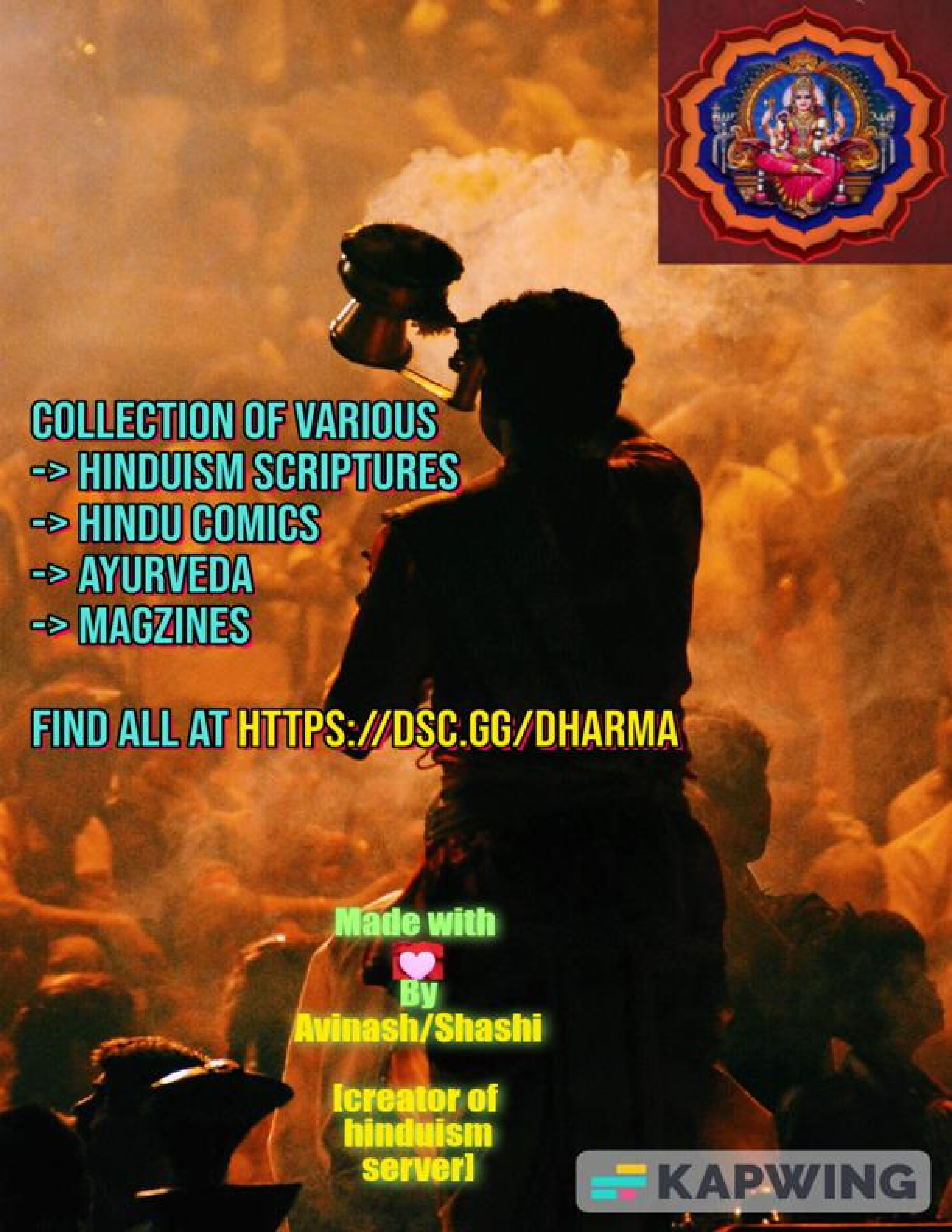
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FOREWORDS

This is an extraordinary book. The authors have curated an extensive selection of research, providing the first state-of-the-art review of yoga therapy as an edited, scholarly, medically oriented textbook with a strong evidence-based focus on research and practice. There is strong representation internationally from both leading yoga researchers and yoga therapists.

There are introductory and concluding sections, examining the background of the subject and providing a perspective on the future. In the body of the book, 60 research scientists have contributed 17 chapters describing the scientific rationale and research evidence for yoga therapy in a variety of conditions. Each chapter includes two senior research investigators in the field in order to ensure a balanced representation and also stronger authority. In addition, 30 experienced yoga therapists have appended to the chapters their perspectives on how to translate this research evidence into practical, clinical applications.

We tend to think of all advances in medicine as being high-tech and expensive, such as a new drug, laser, or surgical procedures. We often have a hard time believing that something as simple as comprehensive lifestyle changes can make such a powerful difference in our lives—but they often do. In our own research, at the Preventive Medicine Research Institute in the United States, we have used some high-tech, expensive, state-of-the-art scientific measures to prove the power of some simple, low-tech, and low-cost interventions. These include:

- yoga (gentle stretching, breathing techniques, meditation, and imagery);
- a whole foods, plant-based diet (naturally low in fat, sweeteners, and refined carbohydrates);
- moderate exercise; and
- social support and community (love and intimacy).

In short—eat well, move more, stress less, and love more.

This lifestyle program is based on what I learned from Sri Swami Satchidananda, an ecumenical spiritual teacher with whom I had the privilege of studying, beginning in 1972. He taught me the importance of addressing the underlying *causes* of many chronic diseases: “For most people, our natural state is to be easeful and peaceful. We are born with ease until we disturb it by making unhealthy lifestyle choices and become dis-eased. We are born fine until we allow ourselves to become de-fined.” In other words, yoga and meditation do not *bring* us health and well-being. Rather, they help us to identify and change behaviors, diet, and perceptions that disturb our inner peace, joy, and well-being, thereby allowing our bodies’ exquisite healing mechanisms to work optimally.

For almost four decades, I have directed clinical research with my colleagues at the non-profit Preventive Medicine Research Institute and the University of California, San Francisco, proving the many benefits of these comprehensive lifestyle changes. These randomized controlled trials and other studies have been published in the leading peer-reviewed medical and scientific journals.

In addition to *preventing* many chronic diseases, comprehensive lifestyle changes can often *reverse* the progression of these illnesses. Our bodies often have a remarkable capacity to begin healing, and more quickly than we had once realized, when we address the underlying lifestyle causes of health and illness.

We proved in randomized controlled trials, for the first time, that lifestyle changes alone can reverse the progression of even severe coronary heart disease. There was even more reversal after 5 years than after 1 year and 2.5 times fewer cardiac events. We also found that these lifestyle changes can reverse type 2 diabetes and may slow, stop, or even reverse the progression of early-stage prostate cancer. And what is true for early-stage prostate cancer is likely true for early-stage breast cancer as well.

Changing lifestyle actually changes your genes—turning on genes that keep you healthy, and turning off genes that promote heart disease, prostate cancer, breast cancer, and diabetes—over 500 genes in only 3 months. People often say, “Oh, it’s all in my genes, there’s not much I can do about it.” But there is. Knowing that changing lifestyle changes our genes is often very motivating—not to blame, but to empower. Our genes are a predisposition, but our genes are usually not our fate.

Our latest research found that these comprehensive lifestyle changes may even lengthen telomeres, the ends of your chromosomes that control aging. As your telomeres get longer, your life gets longer. This was the first controlled study showing that any intervention may begin to reverse aging on a cellular level by lengthening telomeres. And the more people adhered to these lifestyle recommendations, the longer their telomeres became.

While reversing chronic diseases requires intensive changes in lifestyle, it is not all or nothing for preventing disease and staying healthy. In all of our studies, we found that the more people changed their diet and lifestyle, the more they improved and the better they felt—at any age. If you indulge yourself one day, eat healthier the next.

These lifestyle changes are part of the most influential trend in medicine today—what is known as “Lifestyle Medicine,” which is lifestyle as *treatment* as well as prevention. Lifestyle medicine is cost effective as well as medically effective. Our research has shown that when comprehensive lifestyle changes are offered as treatment (not just as prevention), significant cost savings and clinical improvements occur in the first year because the biological mechanisms that control our health and well-being are so dynamic. For example, Highmark Blue Cross Blue Shield found that overall health care costs were reduced by 50% in the first year when people with heart disease or risk factors went through our lifestyle program. In another study, Mutual of Omaha found that they saved $30,000 per patient in the first year in those who made these lifestyle changes.

Because of these findings, we are grateful that Medicare began covering our program of lifestyle medicine in 2011, and most commercial insurance companies have followed their lead. If it’s reimbursable, it’s sustainable.

We are creating a new paradigm of health care that empowers people by addressing the fundamental lifestyle causes of many chronic diseases. Many others are now doing so as well. Who would have thought 40 years ago that Medicare and insurance companies would reimburse yoga and meditation as therapy? We have come a long way.

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Yoga and Western science

> *Undisturbed calmness of mind is attained by cultivating friendliness toward the happy, compassion for the unhappy, delight in the virtuous, and indifference toward the wicked.*
>
> Patanjali, *The Yoga Sutras* (2002)

Sage Patanjali's Yoga Sutras were the most important sutras in the timeless ancient Indian wisdom—*sanathana dharma* —of the Sankhya school of philosophy. The human mind, according to the Sankhya school, has five levels, whereas in English the mind is described in a single word. The mind of an innocent child, filled with universal love, is called *manas* . *Manas* knows no negative traits. Once the child is fed with information in school, the level of mind is called *buddhi* . As the child grows up and acquires more information, the ego gets into the mind. That level of *buddhi* with ego added is called *chitta* . With the arrival of ego, the mind becomes filled with negative traits such as anger, pride, hatred, jealousy, and greed. This is where the mind gets into real problems in the world. Sage Patanjali created the Yoga Sutras to help this agitated mind to become tranquil again and allow it to become filled with universal compassion. The other two levels of the mind are *purusha* and *ishwara* , but these are not relevant to the discussion in this book. "*Chitta vritti nirodahah* " was Patanjali's advice—overcoming the negative thoughts at the *chitta* level was his main concern here.

With the advent of Western science, the mind became defined in a reductionist way, as a materialistic brain-related activity. Today, however, some of the thinkers in the West are slowly returning to the old holistic nonmaterial view of the mind (consciousness) (Wiebers, 2015). Our universe is a living process and not a collection of separate entities. “Consciousness is not contained in the brain matter but consciousness contains all matter and the world,” writes Wiebers (p. 70). This is entirely in accordance with the Sankhya school’s definition of mind. If the human mind is not in the brain, all our healing methods of mental disorders targeting the brain with powerful chemicals do not make sense. Yoga, thus defined, becomes the panacea for most ills of the body and mind. The core identity of man is his consciousness.

The asanas and behavioral rules of yoga (such as the *yamas* and *niyamas*) are but the tools for constant ease in the practice of pranayama and meditation, the integral parts of the yogic science. Science is defined by me as “organized curiosity with logical skepticism”. In that sense the study of yoga becomes a science. In addition, scientific methods of enquiry can now be applied to yoga to see if it helps change the outcomes at the end of the day. The multiple asanas designed by yoga masters reveal the deep knowledge of human anatomy these great sages had. In every single asana the gravity and anti-gravity muscles are so well balanced that one wonders at their access to divine knowledge! They must have also known that stretching would release soothing opioids to the circulation, thus aiding in pain relief. To reiterate, the main thrust of yoga is to bring tranquility of mind, without pharmaceuticals, through masterly breathing techniques collectively called *pranayama* . Slow deep breathing and mindfulness of one’s deep breathing may help almost all the systems of the human body and make the human mind tranquil. Breathing, being the most dominant rhythm in the human system, *mode-locks* all other systems under its control.

My personal research work has taught me one other lesson. The conventional Western cross-sectional reductionist research to show improvement in surrogate end points such as blood pressure, heart rate variability, and so on will limit what we can truly learn from this ancient discipline. The highly regarded but inherently limiting research design of the randomized controlled trial (RCT) will only reveal a portion of the changes that can be achieved through a deep yoga practice and leading a yogic lifestyle. What we need for the future is a more comprehensive *healing outcomes research* approach, which can be discussed separately. It is altogether a major subject in its own right and needs its own discussion. This is the final holistic outcomes research in place of surrogate end points such as blood pressure, blood sugar, etc.

The efforts of this group of researchers to put together a textbook of the yogic sciences is a timely contribution to bring yogic sciences to mainstream healing efforts. The many leading international yoga researchers who have contributed to this volume have presented the scientific rationale for yoga therapy and the existing published biomedical research evidence in a rigorous and comprehensive manner that will be appreciated by both conventional and integrative medicine researchers and clinicians, and the contribution of leading yoga therapists on practical clinical applications is invaluable. Given that this is the first textbook of its kind, it fills an important need, and will therefore serve a significant role for health care and healing in modern society. I wish this book all success.

> “Exercises are like prose, whereas yoga is the poetry of movements.”

Amit Ray, *Yoga and Vipassana* (2010)

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PREFACE

Historically, yoga was a contemplative practice aimed at the transformation of the self through the systematic adoption of specific behavioral and spiritual practices. Although there is little evidence that yoga was originally viewed as a system for the prevention or treatment of disease, its capability of improving psychophysiological functioning was recognized by the fourteenth century, if not before, and it began to be formally utilized as a therapeutic intervention in the early twentieth century. Yoga therapy has since become popular internationally, and the pace of this growth appears to be exponential. This proliferation has been accompanied by an associated increase in both the publication of books on yoga therapy and biomedical research on yoga as a therapeutic intervention for a number of medical conditions. The research evidence base has grown to such an extent that a medically oriented textbook is now possible and warranted. The intention of this text is to serve as a comprehensive resource for physicians and other health care professionals, as well as yoga therapists, instructors, researchers, and practitioners. We are grateful to our yoga research colleagues who have so willingly agreed to contribute chapters reviewing the scientific rationale and the research evidence for yoga therapy for a wide variety of medical conditions. We are also grateful to the many yoga therapists who have contributed practical clinical perspectives. We hope that this text will introduce, elucidate, and promote what we believe is the remarkable potential of yoga practices to serve as a practical behavioral self-care strategy for both disease prevention and therapy, as well as the promotion of overall well-being.

Sat Bir Singh Khalsa, Lorenzo Cohen, Timothy McCall, and Shirley Telles, 2016

EDITORS

Sat Bir Singh Khalsa , PhD, has conducted research in neuroscience, biological rhythms, and sleep since 1978. Since 2001, he has been fully engaged in research on the efficacy of yoga and meditation practices in improving physical and psychological health. He has been personally involved in the practice of a yoga lifestyle since 1971 and is a certified instructor of Kundalini Yoga as taught by Yogi Bhajan. He is currently the Director of Research for the Kundalini Research Institute, Research Director for the Kripalu Center for Yoga & Health, Research Associate at the Benson-Henry Institute for Mind Body Medicine, Board Member of the Guru Ram Das Center for Medicine and Humanology, Scientific Advisor for the Alzheimer's Research and Prevention Foundation, and an Assistant Professor of Medicine at Harvard Medical School in the Department of Medicine at Brigham and Women's Hospital in Boston, USA.

Dr Khalsa has conducted federally funded clinical research trials evaluating yoga for insomnia, post-traumatic stress disorder, chronic stress, and generalized anxiety disorder. His current primary interest is the evaluation of the efficacy of yoga within the academic curriculum of public schools to determine the benefits to students in mental health characteristics, including perceived stress, resilience, emotion regulation, and anxiety; and this work is funded federally and by the Kripalu Institute for Extraordinary

Living. He views yoga as a practice deserving of widespread implementation within society, including into the educational and medical systems.

Dr Khalsa has relationships and collaborations with fellow yoga researchers internationally, working closely with the International Association of Yoga Therapists to promote research on yoga therapy, and serving as the scientific coordinator for the annual Symposium on Yoga Research and as editor-in-chief of the *International Journal of Yoga Therapy* . He is author of the Harvard Medical School ebook entitled *Your Brain on Yoga* and since 2005 he has been teaching an elective course at Harvard Medical School in mind–body medicine.

Dr Lorenzo Cohen is the Richard E. Haynes Distinguished Professor in Clinical Cancer Prevention, Director of the Integrative Medicine Program, and Chief, Section of Integrative Medicine, Department of Palliative, Rehabilitation, and Integrative Medicine at the University of Texas MD Anderson Cancer Center. He is also Distinguished Clinical Professor, Fudan University Cancer Hospital, Shanghai, China. Dr Cohen is a founding member and past president of the international Society for Integrative Oncology and is passionate about educating others on how to prevent cancer and maintain optimal health throughout life. As the majority of cancers are preventable, Dr Cohen is conducting research to demonstrate that lifestyle factors including healthy diet, physical activity, stress management, and social support – in other words, leading a *yogic lifestyle* – can influence cancer outcomes. Dr Cohen leads a team conducting NIH-funded research and delivering clinical care of integrative medicine practices such as meditation, Tibetan Yoga, Patanjali-based yoga, tai chi/qigong, massage, diet, exercise, acupuncture, and other strategies, such as stress management, music therapy, emotional writing, and more aimed at reducing the negative aspects of cancer treatment and improving quality of life and clinical outcomes. He is interested in examining different types of complementary programs that can be easily incorporated into conventional cancer treatments to decrease the psychophysiological consequences associated with treatment and to improve outcomes. Dr Cohen has conducted some of the first randomized clinical trials of yoga in cancer patients and continues this important research today, examining the psychological, behavioral, physiological, and biological benefits of yoga. He was the recipient of the 2007 International Scientific and Technological Cooperation Award of Shanghai Municipality, the 2008 Magnolia Silver Memorial Award, and the 2011 Magnolia Gold Memorial Award for his contributions in furthering research into the use of traditional Chinese medicine.

Timothy McCall , MD, is a board-certified internist and the author of two books, *Examining Your Doctor: A Patient's Guide to Avoiding Harmful Medical Care* (Citadel Press) and *Yoga as Medicine: The Yogic Prescription for Health and Healing* (Bantam Books). He practiced medicine for more than 10 years in the Boston area before devoting himself full-time to investigating and teaching yoga therapy. He is the Founder/Director of Yoga as MedicineSM Seminars and Teacher Trainings and the Co-Director of the Simply Yoga InstituteSM for Yoga Therapy and Holistic Health, in Summit, New Jersey, near Manhattan.

Timothy has traveled extensively, studying with many of the world's leading yoga teachers and yoga therapists including BKS Iyengar and TKV Desikachar. His main teachers have been Patricia Walden, Rod Stryker, and Donald Moyer. He has practiced yoga and meditation from various traditions for over 20 years and Tantra for more than a decade. Since

2005, he has studied with a traditional ayurvedic doctor, Chandukutty Vaidyar, and has spent more than a year at his clinic in Kerala, India.

McCall's articles have appeared in dozens of publications, including the *New England Journal of Medicine, JAMA* , the *Los Angeles Times, The Nation, Redbook* (where he was a contributing editor), the *Philadelphia Inquirer* , and the *Boston Globe* . His column appeared monthly in the newsletter *Bottom Line Health* between 1995 and 2003, and from 1996 to 2001 his medical commentaries were featured on the public radio program *Marketplace.* In 2004–5 he was a scholar-in-residence at the Kripalu Center for Yoga & Health in Stockbridge, Massachusetts, and since 2002 he has been the medical editor of *Yoga Journal.* He has given presentations at medical schools, the NIH, and numerous workshops, and keynote addresses at conferences sponsored by *Yoga Journal* , the International Association of Yoga Therapists, and the Smithsonian Institution. He teaches yoga therapy seminars and teacher trainings in Summit, New Jersey, and worldwide.

Shirley Telles has a degree in conventional medicine (MBBS) after which she completed an MPhil and PhD in Neurophysiology at the National Institute of Mental Health and Neurosciences in Bengaluru, India. Dr Telles' MPhil and PhD theses were related to research on the effects of yoga practice and their applications in health and rehabilitation, and she has continued her research in this area since then. After her doctorate she joined the Swami Vivekananda Research Foundation in Bengaluru and had the unique postdoctoral experience of setting up the laboratories there before starting research. Dr Telles received a Fulbright fellowship in 1998 to assess fMRI in meditators, which was conducted at the Department of Radiology, University of Florida, Gainesville, USA. She has been awarded the first ever Indian Council of Medical Research Center for

Advanced Research in Bengaluru to assess the effects of meditation through autonomic and respiratory variables, evoked and event related potentials, polysomnography and fMRI. This was followed by a grant from the Department of Science and Technology to study attention in meditators using high density EEG and event related potentials during fMRI. Since 2007, Dr Telles has been the Director of the Patanjali Research Foundation in Haridwar, India, which is committed to researching the effects of yoga and ayurveda. She has 152 yoga-related publications cited in major research databases, and is first and main author on most of these. Dr Telles has been invited to talk on yoga and its applications in health and treatment across India and internationally, including Australia, Brazil, Canada, China, Germany, Hong Kong, Norway, Portugal, Serbia, the UK, and the USA. Dr Telles finds that the response to yoga worldwide is interesting and enriching; she is an enthusiastic practitioner of yoga, and believes that yoga research can positively impact all aspects of life.

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DEDICATION

This work is dedicated to the many yoga and meditation masters from the East who have served as teachers and guides, sharing their knowledge and expertise for the purpose of improving human health, well-being, and spirituality. We are especially indebted to those teachers who came to the West to introduce and promote these practices. Their contributions have facilitated a rapprochement between yoga and biomedical science, which has made this book possible.

GLOSSARY

Agni
The ayurvedic principle of digestive fire, which is said to help digest not only food but also emotional and intellectual experience as well.

Agni Sara
Stomach churning, a yogic practice said to build the digestive fire.

Ahimsa
Non-violence to yourself and others. The first of Patanjali's yamas and the foundation of the practice of yoga.

Anuloma-Viloma
Alternate-nostril breathing. See *nadi shodhana* .

Apana
The downward flow of prana in the body, hypothesized in yoga and ayurveda. Apana is said to regulate biological functions such as urination, defecation, and menstruation.

Aparigraha
Non-hoarding. The fifth of Patanjali's yamas.

Asana
Yogic poses or postures. The third limb of Patanjali's eight-limbed system of yoga.

Asteya
Non-stealing. The third of Patanjali's yamas.

Ashtanga Yoga
Patanjali's eight-limbed system of yoga, comprising yama, niyama, asana, pranayama, pratyahara, dharana, dhyana, and samadhi. Also the name of a style of yoga propagated by Pattabhi Jois.

Awareness
The ability to perceive bodily sensations (interoception, proprioception), thoughts, emotions, and so on, said to be increased by the regular practice of yoga. See *mindfulness* .

Ayurveda
India's ancient holistic system of medicine that includes dietary and lifestyle suggestions, bodywork, herbal remedies, and, in ancient times, surgery.

Bandha
Literally, "locks," bandha involves subtle muscular contractions that are said to affect the flow of prana during certain yogic practices such as asana and pranayama. See *mula bandha, jalandhara bandha* , and *uddiyana bandha.*

Bhastrika
A breathing technique in which air is forcefully inhaled and exhaled through the nose, often at rapid rates. See *kapalabhati.*

Bhramari
The bee breath, a pranayama technique, involving humming.

Brahmacharya
Sometimes interpreted as celibacy, but can also be viewed less restrictively to mean to have integrity and to follow the other yamas in sexual relationships. The fourth of Patanjali's yamas.

Chakras
Literally, "wheels," chakras are energy centers that yoga teaches run along the spine from the base (the root chakra)

to the crown of the head.

Dosha
Literally, “that which goes out of balance.” Ayurvedic doshas include kapha, pitta, and vata. When imbalanced, symptoms and eventually disease may result. An out-of-balance dosha is sometimes referred to as “vitiated” or “deranged.”

Dharana
Concentration, the sixth limb of Patanjali’s eight-limbed system of yoga.

Dharma
One’s duty or destiny in life and, by extension, one’s purpose and path.

Dhyana
Meditation, the seventh limb of Patanjali’s eight-limbed system of yoga.

Drishti
The focus of the eyes in yoga practice, for example, looking out over the front hand in warrior II pose.

Eight Limbs of yoga
See *ashtanga yoga* .

Gunas
The three qualities of activity (rajas), inertia (tamas), and balance (sattva) that in yogic and ayurvedic teaching are said to infuse everything that exists.

Guru
Literally, “one who removes darkness.” A teacher.

Hatha Yoga
Literally, “forceful” yoga. The yogic path that includes the yamas, niyamas, asana, pranayama, mudras, and, in some

people's definition, meditation as well. In the West, it has come to be used as a generic term for various styles of yoga that include the physical poses.

Ida
Postulated energy pathway or nadi running along the spine. Ida extends to the left nostril and is associated with relaxation and activation of the parasympathetic nervous system.

Ishvara Pranidhana
Literally, "devotion to God," can be thought of metaphorically as "giving up the illusion of being in control of what happens." The fifth of Patanjali's niyamas.

Jala Neti
Lavaging the nasal passages, usually with warm salt water. A small pot with a thin spout, sometimes called a "neti pot," is often used to deliver a stream of liquid into one nostril that then flows out the other. See *kriya.*

Jalandhara Bandha
The chin lock, used, for example, in shoulderstand.

Kapalabhati
A breathing technique in which the breath is forcefully exhaled and passively inhaled, sometimes at rapid rates. See *bhastrika.*

Kapha
The ayurvedic dosha associated with water and earth. Characterized by inertia and stability, heaviness, and stagnation.

Karma
Literally "action," karma refers to the law of cause and effect. In the yogic view, every thought, word, and deed creates karma and affects what happens to the individual later.

Kirtan
Devotional chanting of Sanskrit mantras in a group setting, typically done in a call-and-response format with musical accompaniment.

Kosha
One of the five sheaths or layers of human existence as postulated in the *Upanishads,* classical yogic texts. The five sheaths include the physical (*anna*), energy (*prana*), lower mind (*manas*), higher mind (*buddhi*), and bliss (*ananda*).

Kriya
Cleansing practices, as in the *shat kriya* (six cleansing practices including jala neti) sometimes used in yoga. In tantra, kriya also signifies individual or sequences of yogic practices designed to have a specific effect.

Kundalini
A storehouse of dormant energy, postulated to lie at the base of the spine. When activated through yogic practices or otherwise, large amounts of prana are said to flow up the spine from the root chakra to the crown of the head. Also the name of a style of yoga propagated by Yogi Bhajan.

Mantra
A word or phrase, often from a sacred text, chanted or said silently to oneself. *Om* is probably the most famous one.

Mindfulness
An intentional state of alert, relaxed, nonjudgmental attention on the present moment and any sensations, thoughts, and so on that arise in the body and mind. See *awareness* .

Mindfulness Meditation
A meditation practice, originating in Buddhism but also used in secular settings, in which the practitioner attempts to hold his or her attention on the present moment, noticing thoughts and sensations that arise in a nonjudgmental

manner. Beginning practitioners often use the breath as a focus. Other mindfulness practices include the cultivation of loving-kindness and other positive mental states.

Moksha
Enlightenment or liberation. The ultimate goal of yoga.

Mudra
Literally, “seal.” Various gestures and positions of the hands and/or body.

Mula Bandha
The root lock. A subtle muscular contraction of pelvic muscles, used at times in asana, pranayama, and meditation.

Nadis
Postulated energy pathways in the body, analogous to the traditional Chinese medicine concept of meridians. See *ida, pingala* , and *sushumna* .

Nadi Shodhana
Literally, “cleansing the energy pathways.” Alternate-nostril breathing. A pranayama practice said to balance the energy between the left and right nostrils and with that the sympathetic and parasympathetic nervous systems. Also sometimes called *anuloma-viloma* . See *ida* and *pingala.*

Niyamas
Personal observances. The second limb of Patanjali’s eight-limbed system of yoga; includes tapas, sauca, santosha, svadhyaya, and ishwara pranidhana.

Ojas
In ayurveda, ojas is the rarified essence of the process of digestion, linked to vitality, immunity, and contentment.

Patanjali
Compiler of the *Yoga Sutras,* the ancient collection of aphorisms that many consider the most important

traditional text on yoga.

Pingala
Postulated energy pathway, or *nadi,* running along the spine. Pingala extends to the right nostril and is associated with activation of the sympathetic nervous system, causing physical and psychological stimulation.

Pitta
The ayurvedic dosha associated with fire and water. Characterized by intelligence, passion, anger, appetite, digestion, absorption, and assimilation.

Prana
The breath, or life force. Analogous to the Chinese concept of *chi* .

Pranayama
Yogic breathing exercises. The fourth limb of Patanjali's eight-limbed system of yoga.

Pratyahara
The turning of the senses inward as when one concentrates on the internal sound of the breath. The fifth limb of Patanjali's eight-limbed system of yoga.

Rajas/Rajasic
A natural tendency, characterized by restlessness/stimulation/heat/bitterness. One of three *gunas* , or "qualities" described in yoga and ayurveda. See also *tamas* and *sattva.*

Relaxation Response
A term coined by meditation researcher Herbert Benson, MD, to denote an endogenous, coordinated response in the body that is essentially opposite in psychophysiological characteristics to the stress response. Evoked by meditative practices that involve sustained control of attention in a relaxed manner on a specific target, e.g. a word, sound,

image or movement, as well as by asana, pranayama, and other mind–body practices. Also describes a simple secular, closed focus/concentrative meditation practice.

Restorative Yoga
A practice of asana in which props such as blankets and bolsters completely support the body, allowing the practitioner to deeply relax while in yoga poses. Invented by B. K. S. Iyengar, but now used widely in many styles of yoga and yoga therapy.

Samadhi
The state of complete absorption. The eighth limb of Patanjali's eight-limbed system of yoga.

Samskara
Ingrained patterns or "grooves" of thought or behavior. In yoga, old samskaras are overcome by establishing new ones.

Sankalpa
The yogic tool of "intention." Intention is what you plan to do, a promise to yourself, not what you hope will happen as a result.

Santosha
Contentment. The second of Patanjali's niyamas.

Sattva
A natural tendency characterized by clearness, purity, balance, vitality, and nourishing. One of three *gunas,* or "qualities," described in yoga and ayurveda. See also *tamas* and *rajas* .

Satya
Non-lying, or truthfulness. The second of Patanjali's yamas.

Sauca
Purity, cleanliness. The first of Patanjali's niyamas.

Self-Realization

In yoga, the identification with the spiritual Self, as opposed to one's material self (mind and body). Also used in psychology to refer to the fulfillment of an individual's character or life purpose.

Sitali (or Shitali)
Literally, "cooling," a breathing practice in which the person inhales through a curled tongue and exhales through the nose. See *sitkari.*

Sitkari
A breathing practice, said to be cooling to the body, in which the person inhales through the gaps between the teeth and exhales through the nose. See *shitali* .

Srotas/Srotamsi
Bodily channels identified in ayurveda, through which nutrients flow and wastes are removed, as in the *majja vaha srotas* (bone marrow, nervous system and brain pathways).

Sudarshan
Literally, "an auspicious vision," as in *Sudarshan Kriya* , a set of breathing techniques propagated by Sri Sri Ravi Shankar.

Surya
The sun, as in *surya namaskar* (sun salutations) and *surya mantras* (chanting various names of the sun).

Sushumna
The postulated central channel, or nadi, through which prana or kundalini energy flows up the spine from the root chakra to the crown of the head. In yogic teaching, sushumna is only opened when ida and pingala are balanced and breathing is equal between the two nostrils, as may happen in meditation.

Sutra
Literally, "thread." An aphorism, as in the *Yoga Sutras* of Patanjali.

Svadhyaya
The traditional meaning of *svadhyaya* was the study and chanting of the scriptures. In more modern usage, it means "self-study." The fourth of Patanjali's niyamas.

Tamas/Tamasic
A natural tendency, characterized by inertia, dullness, and impurity. One of three *gunas,* or "qualities," described in yoga and ayurveda. See also *rajas* and *sattva.*

Tantra
An ancient yogic path emphasizing that enlightenment can come through the body and not only by transcending it, as is taught in the more ascetic, classical yoga paths.

Tapas
Fire, discipline, ardor. The third of Patanjali's niyamas.

Three-part breathing
See *viloma* .

Trataka
A concentration exercise in which one stares at a candle flame or other object.

Uddiyana Bandha
The solar plexus lock. A drawing up the abdomen inward and upward, typically performed during breath holding after a complete exhalation.

Ujjayi
Victorious breath. A sibilant sound made by narrowing the vocal cords. A type of pranayama that may also be done while practicing asana.

Vata
The ayurvedic constitutional type, or *dosha,* associated with air and space. Characterized by mobility, creativity, lightness, dryness, coldness, and irregularity.

Viloma

A breathing practice in which the inhalation and/or the exhalation is divided into discrete segments with pauses in between, e.g., three-part breathing. Also sometimes called “sectional” or “krama (in stages)” breathing.

Yamas
Moral injunctions. The first limb of Patanjali’s eight-limbed system of yoga; includes ahimsa, satya, asteya, aparigraha, and brahmacharya.

Yoga
The state of connection or union. A technology of life transformation. Also often used as shorthand to refer to the practices, particularly asana, that comprise yoga.

Yoga Nidra
Literally, “yogic sleep,” a guided meditation technique, typically performed while lying in shavasana (corpse pose).

Yoga Sutras of Patanjali
The classic text, written circa 200 CE, outlining the theory and practices of yoga.

Yoga Teacher
Someone who teaches yoga; in modern times, typically in a group setting.

Yoga Therapist
Someone who uses the tools of yoga to guide clients seeking relief from physical or psychological symptoms or conditions. Typically taught one-on-one or in small groups, with practices tailored to the individual’s needs.

Yoga Therapy
The application of yogic principles and tools including asana, pranayama, and meditation, as well as dietary and lifestyle advice, to help people with a wide variety of physical and psychological complaints.

Yogi

A committed practitioner of yoga. A female practitioner is sometimes called a *yogini* and a male a *yogin* , though either may be called a yogi.

Yogic
In a fashion consistent with yoga practice and philosophy.

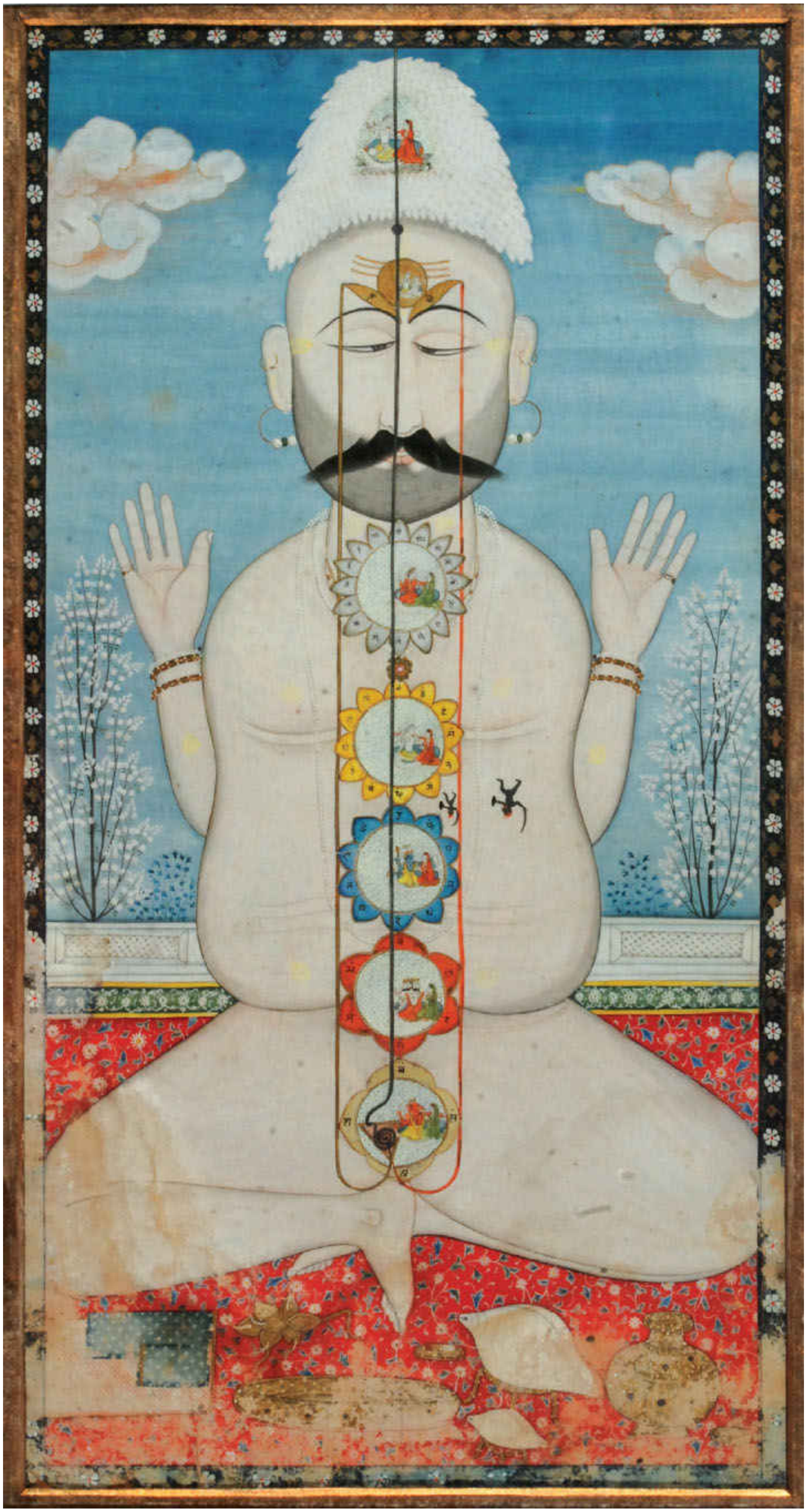

Figure 2.1

Yogin with six *chakras* , India, Punjab Hills, Kangra, late 1700s

Reproduced from the National Museum, New Dehli

SECTION 1

INTRODUCTION TO YOGA AND YOGA THERAPY

Square steatite seal of an individual seated in yogic position with heels pressed together under the groin. An archaeological find from the Indus Valley Civilization (prior to c. 1,500 BCE) in the northwest Indian subcontinent. © JM Kenoyer/Harappa.com , courtesy of the Department of Archaeology and Museums, Government of Pakistan.

CHAPTER ONE

INTRODUCTION TO YOGA IN HEALTH CARE

SBS KHALSA • S TELLES • L COHEN • T MCCALL

The need for this textbook has arisen for a number of reasons. One is the remarkable growth in popularity of yoga practice among the general public. Yoga is found on every continent, in urban and rural areas, in health clubs, yoga studios, church basements, public parks, retirement homes, military bases, high school gymnasiums, corporate boardrooms, and on the wards of major teaching hospitals. In countries where multiple surveys have been conducted over time, the percentage of the population actively practicing yoga is increasing (Ding & Stamatakis, 2014), with US figures growing from 5.1% in 2002 to 6.1% in 2007 to 9.5% in 2012 (Clarke, Black, Stussman, Barnes, & Nahin, 2015). The increase in popularity by 50% in the 5-year span from 2005 to 2012 suggests that this is not a steady linear increase, but rather an exponential one, and it is likely that sometime soon, 15% of the population will be practicing yoga. Indeed, the 2016 Yoga in America Study commissioned by *Yoga Journal* and Yoga Alliance estimated that the number of people practicing yoga in the US is more than 36 million, compared to 20.4 million in 2012. Furthermore, more than one-third of non-practitioners surveyed said they were “somewhat” or “very likely” to practice yoga in the next 12 months, suggesting that 80 million are likely to try yoga in 2016 (http://www.yogajournal.com/yogainamericastudy/). Arguably, yoga has become an integral part of modern society with no signs of diminishing popularity. Examples of yoga’s widespread cultural influence include the proclamation by the United Nations General Assembly in 2014 of June 21 as the annual International Yoga Day; the appearance of yoga practice rooms in major airports; and even the pervasive use of yoga images by the advertising industry.

Yoga therapy, the application of yoga for therapeutic purposes and as preventive medicine, is also on the increase, both in communities and within conventional medical systems. In recent years there has been a proliferation of yoga therapists (yoga teachers with additional training who work with individuals with a broad range of health conditions), yoga therapy training programs, and professional yoga therapy associations such as the International Association of Yoga Therapists, the Australian Association of Yoga Therapists, and the Japanese Association of Yoga Therapists. This growth is linked with and contributes to the expansion of integrative medicine practices, clinics, and centers, as evidenced by the founding and growth of the Academic Consortium for Integrative Medicine and Health.

In turn, this popularity of yoga and yoga therapy has been coincident with, and likely linked to, an increase in both biomedical research on the psychophysiology of yoga practices and clinical trials research on yoga therapy. This research has been driven in part by support of national government agencies that fund research on yoga, including the National Institutes of Health (NIH), especially the NIH’s National Center for Complementary and Integrative Health (NCCIH), in the United States, and the Ministry of Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homoeopathy

(AYUSH) in India. A bibliometric analysis of yoga therapy research publications through 2003 revealed a total of 169 yoga clinical trial research publications (Khalsa, 2004); however, the number grew to 486 through 2013 (Jeter, Slutsky, Singh, & Khalsa, 2015), almost a three-fold increase in 10 years. The total number of published randomized controlled trials (RCTs) that included yoga interventions up to 2014 was 312, of which 205 were therapeutic efficacy trials and the remainder basic research trials (Cramer, Lauche, & Dobos, 2014). All three of these bibliometric analyses have demonstrated accelerating growth in the biomedical research on yoga and yoga therapy. The quantity and quality of this research has been sufficient to lead in turn to the publication of an increasing number of systematic reviews and meta-analyses of yoga trials (Bussing, Michalsen, Khalsa, Telles, & Sherman, 2012). The most obvious example of this is the expansion in cancer-related yoga research, with over a dozen systematic reviews or meta-analyses published through 2013. It is this growth in research on yoga and yoga therapy that has allowed for the publication of this book. One underlying reason for this boom in popularity and research in yoga and yoga therapy appears to be the burgeoning incidence of chronic lifestyle diseases, which our health care systems, and society as a whole, are failing adequately to address.

Yoga in lifestyle and stress-related diseases

Modern medicine has made tremendous progress in controlling infectious/communicable diseases such as tuberculosis, polio, and smallpox. In fact, communicable diseases are no longer the main cause of death worldwide. It is now the noncommunicable diseases (NCDs), in which lifestyle is the major causative factor, that have reached epidemic proportions, causing the majority of deaths worldwide. Indeed, NCDs are responsible for more deaths in developing countries than all other causes of mortality combined. Countries such as India and China now lead the world in the incidence of type 2 diabetes (T2DM) and likely soon will have the highest incidence of cancer as well, largely due to the widespread adoption of elements of a Western lifestyle. The World Health Organization (WHO) estimates that 80% of the NCD deaths are due to four main disease groups: (1) cardiovascular disease (heart disease and stroke); (2) cancer; (3) diabetes; and (4) respiratory diseases. Furthermore, NCDs are rapidly increasing in prevalence (Hunter & Reddy, 2013). The good news is that the overwhelming majority of the incidence of deaths from these four disease groups appears to be preventable (McGinnis & Foege, 1993).

These four disease groups are in large measure caused by four shared behavioral risk factors: tobacco use, physical inactivity, unhealthy diets, and the harmful use of alcohol (that can be viewed as an aspect of one's diet) (Hunter & Reddy, 2013). To that list, one can add chronic psychological stress, which has both direct and indirect effects on NCDs by changing biology and influencing behavior. And, chronic stress in the modern world is highly prevalent. The American Psychological Association's annual *Stress in America* surveys have been conducted since 2007

(American Psychological Association, 2014). In the 2014 survey, 42% of adults reported not doing enough to manage their stress or not being sure if they are doing enough, and 20% said they are not doing anything. Those of lower socioeconomic status—and greater NCD risk factors—reported greater stress levels than those of higher income. Other groups found more likely to be affected adversely by stress included women and young adults.

It is now widely accepted that modification of behavior in these four areas: (1) no tobacco use, (2) increasing physical activity, (3) eating a healthy diet with no or moderate alcohol consumption, and (4) managing stress could prevent the majority of disease-related suffering and deaths in our world, as well as the enormous expenses, both societal and individual, they cause. Yet, our health care systems, and the world as a whole, have made little investment in the area of NCD prevention relative to the investments in treatment, and treatment strategies have fallen short in trying to control NCDs. And this is an area where yoga can be extremely helpful. Although yoga is often perceived in the West as a form of physical activity with a focus mainly on movement and stretching, there are many Western yoga schools and styles incorporating traditional yoga practices, which include breathing exercises, deep relaxation, and meditation, among several others (see Chapter 2). In addition, many serious practitioners, including most yoga therapists, go beyond basic aspects of yoga to lead what can be called a “yogic lifestyle.” This lifestyle includes abstaining from tobacco; little or no alcohol consumption; maintaining a healthy diet with a focus on fresh, unprocessed, plant-based vegetarian or vegan foods; incorporating mindfulness into all behaviors and interactions; and leading a balanced life with a strong commitment to healthy behaviors. Clearly, broad adoption of a yogic lifestyle could help prevent many NCDs.

In addition, yoga’s ability to help manage the stress of modern life has been well documented (Sharma, 2014). Maintaining health and fitness and managing stress are the leading reasons people indicate they adopt yoga practices (Penman, Cohen, Stevens, & Jackson, 2012; Quilty, Saper, Goldstein, & Khalsa, 2013). Effectively managing stress is critically important, because uncontrolled chronic stress has been recognized as either an etiological factor in certain medical conditions (e.g., heart disease), can precipitate medical conditions in at-risk populations (e.g., obese individuals), or is a negative prognostic indicator in people struggling with chronic health conditions (e.g., cancer). Poorly controlled chronic stress increases the risk for heart disease (Torpy, Lynm, & Glass, 2007), myocardial infarctions (Li, Zhang, Loerbroks, Angerer, & Siegrist, 2015), sleeping difficulties (Cohen, Janicki-Deverts, & Miller, 2007), digestive problems (Chang, 2011), progression of disease in cancer patients (Satin, Linden, & Phillips, 2009), and depression (Hammen, 2005). Chronic stress may literally speed the aging process through telomere shortening (Epel et al., 2004). Moreover, stress can lead patients to engage in dysfunctional coping strategies such as smoking and substance abuse and to forego healthy eating and exercise habits, all of which increase the risk for NCDs.

Each disease condition chapter in this book has a section describing the psychophysiological rationale for the application of yoga for that condition. What is seen across most of these chapters is the pivotal role of yoga in countering stress and inflammatory processes—inflammation is a common etiological factor of many of the NCDs (e.g., heart disease, diabetes, many cancers, etc.). It is now well recognized that chronic stress affects almost every biological system in the body and leads to chronic inflammation (Chrousos & Gold, 1992). Stress can have a direct effect on diseases (e.g., increasing platelet-clotting time relevant to myocardial infarction) and indirect effects on diseases (e.g., increased cortisol levels promoting visceral fat deposition, which heightens the risk of developing metabolic syndrome). By decreasing the activity of the sympathetic nervous system (SNS) and hypothalamic–pituitary–adrenal (HPA) axis, yoga can reduce the downstream harm attributable to chronic stress. In fact, emerging research is showing that lifestyle factors such as diet, exercise, stress management, and sleep quality (which yoga also appears to improve) can positively influence health states and the underlying biological processes that help to maintain health and well-being (Ornish, Magbanua et al., 2008; Ornish, Lin et al., 2008; Puterman, Lin, Krauss, Blackburn, & Epel, 2015) (see Chapter 21).

The complementary worldviews of yoga and modern medicine

Another reason for yoga therapy's increasing popularity is that its approach is consonant with many people's values: it is a natural, mind–body treatment that is low-tech, relatively inexpensive, and generally very safe. Despite the growing use of mind–body approaches for healing among patients, our health care systems have generally neglected these and other behavioral treatments, focusing instead on pharmaceuticals, surgical procedures, and other invasive treatments. Psychosocial and spiritual influences on healing have also been largely overlooked. Forgiveness, acceptance, fulfilment, a sense of meaning, a lessening of suffering—all areas that the yoga therapist may help patients to cultivate—may be more amorphous and harder to quantify than serum cholesterol and systolic blood pressure, yet they are all vital to health and well-being and to many who seek medical care. In addition, in spite of the tremendous successes of technological approaches, many feel that in modern health care a personal touch can be missing. Like other treatments grouped into the category of complementary and integrative medicine, yoga therapy is client centered. Clinical sessions allow ample time for patients to tell their stories and get an attentive evaluation of their complaints, one that is not solely focused on either just physical or just psychological symptoms, but on all aspects of a patient's life: physical, psychological, social, and even spiritual (McCall, 2007).

In modern medicine, whenever possible, physicians practice evidence-based medicine, in which treatment decisions are based mainly on research using third-person objective outcomes and not on patient-reported subjective outcomes. However, while welcoming the contributions of science, yoga has a different opinion about personal testimony.

According to yoga epistemology, *direct experience* is the most reliable way of figuring out what is true (Bryant, 2009). But in order for direct experience to be reliable, yoga teaches that one must first remove *obstructions to clear sight* . Yoga is a step-by-step path to improve one's perceptive abilities, awareness, and mindfulness, often starting with the body but extending to the breath, the nervous system, and the mind. In modern medical science, following the tenets of evidence-based medicine, physicians whenever possible rely on RCTs and meta-analyses of large groups to determine the best approach for treating individuals. In yoga therapy, in contrast, the practitioner studies the individual in great detail and crafts a yoga program to address the various imbalances that have been detected. Examples of this approach can be seen in the clinical sections of each disease-condition chapter in this book, which feature the work of leading yoga therapists.

Over time, a yoga student's proprioceptive and interoceptive abilities grow through the practice of yoga postures and breathing techniques (Farb et al., 2015; Schmalzl, Crane-Godreau, & Payne, 2014). Areas of the body that once were dim to awareness become more readily perceptible, and with ongoing practice, this perception becomes heightened. Similarly, meditation builds the ability to know one's own mind, with an overall increased sense of awareness/mindfulness that includes thoughts and emotions previously unavailable to the conscious mind. These cultivated perceptual abilities of body and mind, which are developed and enhanced with practice over time, affect how yogis interact with modern medicine, for example, by facilitating the early detection of disease symptoms and risk factors. Thus, long-term or master practitioners of yoga may realize that they are developing pneumonia in a specific area of their lung because they can feel that the tissue is not responding normally during subtle breathing practices

(Judith Lasater, personal communication). We might compare it to a highly trained musician who senses that his or her instrument is slightly out of tune.

When examining reality through the lenses of *both* of these very different paradigms—one focused on individuals, cultivated awareness, and first-person outcomes and the other on more objective third-person outcomes and statistical analysis of groups—the observer may get a more nuanced and accurate overall view, because each approach may detect some truths that the other misses. Although yoga's methodology is different from that of modern medicine, most yogis consider these paradigms to be complementary and have welcomed the scientific investigation of yoga and yoga therapy. Similarly, modern medicine is becoming increasingly open to what yoga has to offer.

Disease as understood in ancient yoga texts

In ancient Indian texts, much importance is given to maintaining a state of balance or homeostasis (called *samatvam* in Sanskrit) within the individual. In fact, in the *Bhagavad Gita* , a Hindu scripture compiled circa 500 BCE , the word *samatvam* is considered synonymous with yoga: *Samatvam yoga ucyate* , "yoga is equilibrium" (*Bhagavad Gita* , Chapter 2 , Verse 48; Prabhavanada & Isherwood, 1944). We now know from modern medicine that a shift away from physiological or biological homeostasis can indeed lead to disease (e.g., immune suppression can increase vulnerability to viral infections or cancer; increased blood pressure can lead to heart and renal disease).

Beyond the dimensions of a healthy yogic lifestyle discussed above, the ancient yogis stressed the importance of managing one's emotions and attempting to modify unhealthy thought patterns. Thoughts and emotions are considered important because of the way disease is believed to originate. According to yoga texts, there are five levels of existence, sometimes referred to as the *koshas* (*Taittreya Upanishad*). These are (1) the physical level, (2) the subtle-energy level, (3) the instinctual mental level, (4) the intellectual mental level, and (5) the fifth and ideal level, a state of optimal homeostasis and balance. Many imbalances that can lead to disease are thought to begin at the instinctual mental level.

Mental imbalances are believed to occur due to five main stress-producing factors (called *kleshas* , in Sanskrit; Patanjali's *Yoga Sutras* , Chapter II, Verse 3, *avidyasmita-raga-dvesabhinivesah klesah*) (Bryant, 2009). The five kleshas are (1) ignorance about the true nature of the Self (*avidya*); (2) strong desires (*raga*), (3) strong aversions (*dvesha*); (4) a sense of self/separateness (*asmita*); and (5) fear of various things, the most extreme being death (*abhinivesha*). According to ancient texts, the first overt manifestation of these imbalances is at the level of subtle energy (called *prana*), which results in irregular breathing. In Patanjali's *Yoga Sutras* , universally considered as a seminal ancient text on the fundamentals of yoga, it says, "The symptoms or manifestations of this distracted state (*vikshepa*) are mental pain, anguish, turmoil, despair, tremors, rough and erratic breathing, and general nervousness and anxiety" (*dukha-daurmanasyangamejayatva-svasa-prasvasa viksepa-sahabhuvah;* Patanjali's *Yoga Sutras* , Chapter I, Verse 31) (Bryant, 2009).

If at this stage an individual can realize that something is wrong (e.g., a dysfunctional breathing pattern, a diet that promotes weight gain, a tendency to hyperextend the lumbar spine), he or she may be able to make the necessary changes to correct the imbalance and possibly prevent disease. This is where the heightened awareness and mindfulness, which a regular yoga practice facilitates, becomes important. According to yoga texts, however, what usually happens is that imbalances in the mental state, breathing, and elsewhere (what in the parlance of modern medicine might be considered disease risk factors) continue unchecked and tend to deepen over time. After a while, physical disease manifests, as the imbalances that began at the mental level reach the physical level. This, according to the yoga tradition, is the basis for a wide spectrum of conditions that may be considered to have a psychosomatic basis. That some individuals develop a disease of the respiratory system, while in others the cardiovascular or nervous system is involved, may be due to a genetic predisposition to a particular disease or an inherent weakness or vulnerability of a particular system. By detecting imbalances before full-blown disease manifests, yoga therapy can be a powerful form of preventive medicine, particularly for the lifestyle diseases that remain a struggle for modern medicine to manage.

The clinical practice of yoga therapy

In assessing patients, the yoga therapist considers all aspects of the patient's mind, body, and spirit, as well as family situation, work environment, socioeconomic level, and cultural factors. Based on this detailed analysis, a personalized therapeutic strategy is tailored to the individual and may be altered regularly over time, as the individual's situation changes (Desikachar, Bragdon, & Bossart, 2005; Kraftsow, 1999; McCall, 2007). The yoga therapist's analysis often begins with the body. How is the person's posture? Are the joints stiff or limber? Are the muscles contracted or loose (or is there, as commonly seen in yoga therapy clients, a complex pattern of overwork in some areas of the musculature and underwork in others)? What about the breath? Does the person breathe through the mouth or the nose? Is the inhalation smooth or rough? Is there inadvertent breath holding? How is the balance of the autonomic nervous system?

Most yoga therapists and many yoga teachers are knowledgeable about subtleties of human anatomy. Although they often think about individual muscles the way doctors do, many see patterns of anatomical alignment and kinesiology with a level of detail well beyond what the average physician might notice. Good yoga therapists, for example, routinely notice how subtle misalignments of the feet and/or ankles can contribute to back pain and will incorporate strategies to address such imbalances in their treatment plans.

Increasingly, many yoga therapists base their observation of patients on principles that come not just out of yoga but also from the related field of ayurveda, the ancient indigenous medicine of India. Like the Hippocratic medicine of ancient Greece, ayurveda diagnostically evaluates factors such as bodily humors (*doshas*), seasons, climatic conditions, and the strength of the *agni* , or digestive fire (Caldecott, 2006; Svoboda, 1998). This may be off-putting to some physicians who have been taught to distrust such systems, but many yoga therapists find that ayurvedic principles are invaluable in helping them craft personalized yoga programs and tailor dietary and lifestyle advice to the individual patient (McCall, 2007).

In addition to investigating mental balance and stress levels, yoga therapists evaluate the patient’s overall psychological well-being. Yoga therapists are not attempting to be psychotherapists; rather, they recognize dominant emotions such as anger, fear, or sadness, as well as dysfunctional psychological patterns in their patients. This can help them to better understand their patients and to craft individualized therapeutic programs. Similarly, yoga therapists, with patients who are willing, can assess spiritual well-being. Many yogic approaches are explicitly designed to foster spiritual goals, such as cultivating compassion for oneself and others and reducing suffering (whether pain can be diminished or not) (Feuerstein, 2001).

Yoga therapy’s comprehensive approach

Consideration of a patient’s entire situation—body, mind, spirit, and environment—is a manifestation of holism, more commonly referred to in the clinical context as holistic medicine, or more recently as integrative or participative medicine. Conventional medicine, in contrast, tends to focus on discrete and often isolated targets when assessing a patient and his/her condition. In its most limited form, which is unfortunately too often the case, the goal of conventional medicine is to relieve the overt symptoms without much effort devoted to determining and treating the underlying causes. An alarming example is the preferred strategy to focus on pharmaceutical and technological solutions to the epidemics of obesity and T2DM, with much less emphasis on addressing the underlying behavioral and lifestyle causes. Another example is the overuse of surgery to treat low-back pain. At its best, when conventional medicine does focus on the cause of the disease, it typically does so with a limited and narrowly focused strategy, often limited to the use of medications and surgery. Historically, this has worked well for communicable diseases, but is less likely to be effective for diseases with multiple interacting risk factors. This is reductionism in modern medicine: reducing the complexity of the whole to a single or a few causative factors that can be attacked. Of course, reductionism, which includes the study of individual organs, cells, and metabolic pathways, has been one of the greatest successes of modern science and medicine. But from the yogic point of view, it is a limited approach that is likely to miss factors that may make the difference between success and failure in clinical treatment.

A holistic, integrative approach, by contrast, tends to view disease as multifactorial, with many factors and functions densely interconnected. Even if there is a specific cause behind a condition, such as a virus, it is well known that people with similar exposure to a pathogen may have widely divergent clinical outcomes, from no symptoms to debilitating disease (Pedersen, Zachariae, & Bovbjerg, 2010). Even when there is an obvious cause of the patient's ailments, the yoga therapist will nonetheless assess the individual and plan the intervention in a comprehensive manner. Thus a patient with back pain due to a herniated lumbar disc might be given practices designed to improve spinal posture (alignment), correct dysfunctional breathing habits, lower stress levels, deal with unresolved anger, and help find a sense of meaning or purpose in life. Of note, different patterns of postural dysfunction, breathing habits, and emotional and spiritual issues would alter the yoga therapist's approach, because of the patient-centered, individually tailored approach of yoga therapy.

An integrative approach usually involves using multiple, generally safe approaches simultaneously, some aimed at the physical body, others at the emotions and/or spirit, to induce improvement in the patient's psychophysiological functioning. In yoga therapy, these approaches may include a combination of postures (*asana*), breathing practices (*pranayama*)*,* meditation (*dhyana*), and lifestyle advice*.* An integrative approach favors gentle, natural remedies but, when necessary, also supports the use of reductionist tools such as pharmaceuticals and surgery. Indeed, yoga therapy is often used as an adjunct to conventional medical treatments. An appropriate analogy would be to compare integrative medicine's holistic approach to organic gardening, where efforts are made to strengthen the soil and make the plant hardier to better resist insects, as opposed to the reductionist approach of simply applying pesticides, but sometimes both are needed to help the garden to flourish. The beauty of a comprehensive approach is that treatment does not necessarily depend on the medical diagnosis and may therefore be helpful even in cases where the diagnosis is unclear or even wrong, which autopsy studies have suggested is surprisingly all too common (Shojania, Burton, McDonald, & Goldman, 2003; Winters et al., 2012).

Although yoga therapy can occasionally cause untoward reactions (see Chapter 22), by and large, its side effects are positive. Because of its comprehensive approach, a variety of imbalances may be simultaneously corrected, potentially benefitting both the primary diagnosis as well as comorbid conditions, possibly leading to the prevention of other diseases. A yoga practice prescribed and adopted for treating hypertension, for example, might not only lower blood pressure but also result in better sleep, improved immune function, elevated mood, and greater resilience in the face of unavoidable stressors. The side effects of a reductionist approach, in contrast, are almost always undesirable because the focus on correction of just one symptom or disease manifestation (high blood pressure, for example) results in imbalances in other parts of the system.

However, the Achilles' heel of most holistic approaches, which applies to all of behavioral and mind–body medicine, is that they place the burden on patients to execute the vast majority of the therapeutic intervention. It is the patients who will need to practice their yoga poses, sit on their meditation cushions, write about emotionally painful experiences in their journals, or shop at the farmers' market to reduce the amount of processed food they are eating. This is not easy for many patients in modern society, who are busy and have grown accustomed to the generally accepted paradigm in modern health care that the physician is responsible for the patient's health, and that the patient generally visits the provider only to "get fixed when something breaks," without necessarily addressing how his or her own behavior may have contributed to the health problems. In fact, many patients will spurn a prescribed lifestyle change or behavioral intervention in favor of the quick fix of surgery or a pharmaceutical: "*Why go through the hassle of practicing yoga, when you can just take a pill?"*

The lack of involvement of patients in their own health care can have negative consequences beyond the side effects of pills they might not otherwise need. In much of conventional medicine, the patient is passive, someone to whom procedures are done, with little control of outcome and a minimal sense of self-efficacy. The resulting lack of empowerment can be discouraging, particularly when the treatments have limited benefit and unpleasant or dangerous side effects and may keep the body's stress responses activated. Beyond a potentially helpful healing option, what yoga offers patients is a sense that their actions are making a palpable difference in their health and well-being. That realization can alter the mindset from feeling like a passive victim to feeling like a person with some control over what happens—which in itself may be therapeutic.

Yoga practitioners believe that although some health outcomes are unavoidable, in large measure what we do—particularly what we do regularly on a day-to-day basis—has a powerful effect on what happens to us in the future. In the words of Patanjali, "Future suffering can be avoided" (*heyam duhkham anagatam,* Pantanjali's *Yoga Sutras,* Chapter II, Verse 16) (Bryant, 2009). Despite a patient's genetic predisposition for a particular disease, adoption of appropriate behaviors and practices may effectively prevent manifestation of that disease. To put it in yogic terms, some *karma* can indeed be changed, and yoga therapy is a process that helps individuals—and society—to do just that.

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CONTENT AND STRUCTURE OF THIS TEXTBOOK

The 23 chapters in this textbook are divided into eight sections. Section 1 provides introductory chapters for yoga, yoga therapy, and the basic research on the psychophysiology of yoga. Sections 2 through 7 cover yoga therapy for separate fields of medicine and medical conditions. Section 8 includes chapters on practical implementation issues and future directions for the field. Authors for all of the chapters were invited to contribute based upon their international scholarly leadership in a specific field of yoga, yoga therapy, and/or yoga research. For each chapter, at least two senior academic scholars/scientists from different institutions served as key leading coauthors in order to provide greater expertise, knowledge, and balance to the text; in a number of chapters these senior authors were assisted by other coauthors of their choosing. The structure of each of the 17 clinical chapters in Sections 2 through 7 includes: (1) an introduction/description of the disease category, including pathophysiology, etiology, and prevalence of the medical condition(s); (2) the psychophysiological rationale for the use of yoga for the condition(s); (3) a review of the published clinical trial evidence, including the number of studies, diversity of study characteristics, and quality of research design; (4) a concluding summary including clinical relevance and future research directions; and (5) a limited number of key citations.

Following each of the 17 clinical chapters is a section consisting of clinical insights from yoga teachers and yoga therapists, contributed in part by invited prominent international yoga therapy practitioners listed on page xix as Consulting Yoga Teachers and Yoga Therapists. These sections were compiled and written by Timothy McCall, and the opinions in them do not necessarily reflect his opinions nor those of the authors of the clinical chapters which they follow. The sections are designed to describe how highly experienced practitioners from a variety of yoga traditions (often with quite different perspectives) approach their work. Their observations and recommendations are illustrative, and are based more on the yoga tradition and their own direct clinical experience than on the results of clinical trials. They should not be construed as treatment recommendations, as such practices may not be appropriate for all patients. Especially for those with medical conditions or frailty due to advanced age, yoga should be learned under the supervision of a qualified yoga teacher or yoga therapist. While books and videos can support this process, they are no substitute for the care, attention, and feedback that a well-trained instructor can provide.

CHAPTER TWO

HISTORY, PHILOSOPHY, AND PRACTICE OF YOGA

R SOVIK • AB BHAVANANI

Historical background, antecedents, and development of the eight-limbed path

Yoga is both a process and a goal. In this respect, it is a *moksha shastra, a* teaching (*shastra*) leading to gradual freedom (*moksha*) from the various forms of human suffering. The word *yoga* is derived from the Sanskrit verb root *yuj* , which means “to yoke, unite, or bring together.” Yoga can be defined both as the effort to restore harmony within the body–mind complex and as the effort to reunite the individual human spirit with its essential nature (Schweig, 2007). Although the practice of yoga does not exclude any religion, creed, or race, it is helpful to recognize that its teachings have sprung from the spiritual soil of ancient India and even now bear the title in India of *sanatana dharma* , “eternal way” (see Box 2.1).

Although yoga has been practiced in India since well before recorded history, it was in approximately the second century BCE that the seminal figure Patanjali united many already-existing practices and writings into a unified text known as the *Yoga Sutras* . Patanjali’s masterful Sanskrit work contains a series of 195 terse aphorisms (*sutras* , or “threads”) that convey the most essential ideas of yoga theory and practice. These sutras present the essence of yoga in the form of eight divisions, or limbs (*ashtanga yoga*) (Bryant, 2009). The first five limbs of this system are termed “external” because they address relationships with the world and with the body, breath, and senses. The “internal,” or “mental,” rungs of yoga, the last three of the eight limbs, comprise three increasingly refined stages of concentration.

Box 2.1 Yoga briefly defined

What is yoga?

- Mastery of the roaming tendencies of the mind – *Yoga Sutras* (1.2)
- Skillful, dispassionate action – *Bhagavad Gita* (2.50)
- Equanimity of mind – *Bhagavad Gita* (2.48)
- A skillful and subtle process of calming the mind – *Yoga Vashistha* (3.9.32)
- Dissociation from the painful union with suffering – *Bhagavad Gita* (6.23)
- Unity of breath, mind, and senses, and the abandonment of distracting thought – *Maitri Upanishad* (6.25)
- Union of the individual self (*jivatma*) with the Universal Self (*Paramatma*) – *Yoga Yajnavalkya* (1.44)

At the heart of Patanjali's text is the message that every human being is by nature balanced and whole (Gitananda, 1999). Yoga is a method for aligning oneself with this sense of inner balance. In the process, multiple levels of human experience—body, breath, and mind—are given thorough attention, and the mind is gradually freed for deeper concentration and reflection.

Many modern practitioners have become interested in yoga as a means for improving health. Patanjali recognized imbalances in health as a significant obstacle to personal progress (Aranya, 1983) and approached the task of promoting good health in two ways: by removing obstacles that block the path to health and by promoting alignment with healing forces within. As we shall see, these two strategies are manifested in a wide variety of approaches to self-management.

It is important to recognize that the modern, almost exclusive, identification of yoga with physical exercise is just that—a recent development. As Patanjali illustrates, yoga practices in earlier times embodied a thoroughly integrated approach. They combined in one system the goals of improved health, self-discovery, and spiritual self-understanding.

Major historical time frames

Vedic period (circa 1500–600 BCE)

In the period before written texts, teachings were transmitted orally from teacher *(guru*) to disciple (*shishya)* . The earliest of these teachings are found today in four compilations: the *Rig Veda,* the *Yajur Veda,* the *Sama Veda,* and the *Atharva Veda* . The age of these works has been a matter of some uncertainty (Bhavanani, 2010). It is estimated that although the oral tradition extends far back into prehistory, the Vedas as they are organized today date from circa 1500 BCE , with later additions extending to 600 BCE (Panikkar, 1977). Each Veda (from the root *vid* , "to know") consists of four parts. The *Samhitas* , collections of hymns used in Vedic rituals, form the oldest portion. The *Brahmanas* and *Aranyakas* comment on and expand the *Samhitas* , while the *Upanishads* form the final portion of the texts. The Vedas promote harmonious relationships with nature, appeal for peace in human interactions, petition for health and protection, and most importantly, bring awareness to the meditative dimensions of human life.

Post-Vedic era (circa 600–100 BCE)

In the period following the compilation of the Vedas, an enormous collection of teachings was recorded and made available for practice and study. Twelve *Upanishads* and their comprehensive interpretation, the *Brahma Sutras* , began the shift away from Vedic rituals to the highly personalized yogic goals of self-development, balanced living, and Self-realization. A diverse literature emerged that included two epic texts, the *Ramayana* and *Mahabharata,* and the latter's well-known quintessence, the *Bhagavad Gita* . Yoga practices were codified in the *Yoga Sutras* of Patanjali (c. 200–100 BCE), and Patanjali's writing was accompanied by an authoritative commentary added by the sage Vyasa.

One hundred BCE and through the seventeenth century CE

During the common era, devotional works, histories, and teachings of yogic adepts all provided a resource for practicing yogis. The renowned philosopher Shankaracharya (eighth century ce) had a profound influence on the thought of this period. He revived the doctrine of *advaita vedanta* , nondualism, and wrote authoritative commentaries on the *Bhagavad Gita* , the *Brahma Sutras* , and 10 major *Upanishads* . During this period, many types of yoga emerged from within the diverse traditions of India. Georg Feuerstein (2003) has listed 40 types of yoga ranging across a broad array of practice approaches. Among these, the three main ones surviving into the modern age are the *Yoga Sutras* of Patanjali; the hatha yoga teachings of the *Natha* sect of yogis (in particular, a fifteenth-century work by Svatmarama, the *Hatha Yoga Pradipika,* and a seventeenth-century work of Gheranda, the *Gheranda Samhita*); and the teachings of the *Bhagavad Gita* .

Modern era

In the modern period, yoga and its teachings traveled from East to West, a phenomenon embodied first by the arrival of Swami Vivekananda in the United States in 1893. Drawing on the teachings of the *Bhagavad Gita* , he wrote on each of the four paths found there: raja yoga (meditation), karma yoga (selfless action), bhakti yoga (devotion), and jnana yoga (metaphysics). In the early twentieth century, Swami Kuvalayananda of the Kaivalyadhama Yoga Institute, as well as Yogendraji of the Yoga Institute in Mumbai, initiated systematic practice and research in yoga. Since then, various traditions have spread worldwide. These include teachings set in motion by T. Krishnamacharya (who inspired well-known practitioners of yoga such as B. K. S. Iyengar, T. K. V. Desikachar, and Pattabhi Jois); Swami Shivananda Sarasvati (and his disciples Swamis Satyananda, Vishnudevananda, and Satchitananda); the Himalayan tradition (Swami Rama, Pandit Tigunait, and Swami Veda Bharati); the Kundalini Yoga tradition (Yogi Bhajan); the Self-Realization Fellowship (Swami Yogananda); and the Rishiculture of Swami Gitananda Giri (Yogacharini Meenakshi Devi Bhavanani). Yoga practitioners and scientists such as H. R. Nagendra and R. Nagarathna of S-VYASA (Swami Vivekananda Yoga Anusandhana Samsthana) University in Bangalore continued the early efforts of Swami Kuvalayananda with a special emphasis on yoga as therapy. Since 2002, Swami Ramdev has popularized yoga throughout India as well as initiating research to study its effectiveness in health care. Other recent schools of practice are listed in the final part of this chapter. Notably, while yoga teachings have been derived from many written sources, it is the presence of a living lineage of teachers (a *guruparampara)* that provides assurance that a particular teaching is genuine.

Foundations of yoga practice

In the initial stages of yoga study, most students focus on postures (*asana*), voluntary regulation of the breath (*pranayama*), and relaxation skills (*pratyahara*). Integrated with contemplation of the *yamas* and *niyamas* (described below), these form the foundation for the development of an effective practice. However, it is helpful to broaden the focus here in order to provide a philosophical context and illustrate the manner in which yoga techniques expand into daily life. Yoga is indeed a way of life, an experiential investigation into human nature (Bhavanani, 2013). (See Table 2.1 , p. 25.)

The essence of yoga is self-observation. It is through self-observation, for example, that the refinement of yoga postures occurs. In the course of asana work, self-observation brings with it a sense of psychological distance from the body—a perception that there is space between the witnessing mind and the movements and alignment of the physical self. A unique sense of objectivity develops—an awareness that the observer, the process of observation (carried out in the mind), and the object being observed (the body and its movements) are distinct parts of an integrated inner experience. This, in turn, leads to a deep sense of physical self-mastery and the feeling that one's body has become "like the wide expanse of the sky" (*ananta samapatti*) (Aranya, 1983, p. 229).

A similar but more subtle process occurs when the breath becomes the object of attention. In this regard it is often declared that without the breath there is no yoga. Observation of the breath calms emotional reactivity, heightens awareness of the energetic dimensions of human life, and awakens the witnessing mind. Breath awareness begins with the continuous awareness of the flow of exhalation and inhalation. Each exhalation provides a pleasant sensation of cleansing, while each inhalation offers an equally pleasant sense of nourishment. Attention to these streams of air results in the development of effortless, relaxed breathing.

The most refined development of self-observation occurs in meditation. There, the process of witnessing lies entirely within the mind itself. The ever-present stream of thought, emotions, memories, sensations, and states of consciousness forms an object of attention. Gradually, as the observation of the mind is steadied through concentration, the individual's identity as the inner witness is revealed and consciousness rests within itself (Tigunait, 2014).

The eight limbs of yoga

The ashtanga ("eight-limbed") yoga system of Patanjali, as described in the *Yoga Sutras* , provides the discipline, guidance, and vision necessary for an understanding of yoga. Although the first five limbs form steps leading to meditation, practitioners are not expected to perfect these before proceeding on. Learning yoga is an organic process, and the various practices of yoga mutually clarify and support one another until the higher limbs can be achieved.

The first two limbs of practice consist of strategies devoted to self-regulation. They begin with the *yamas,* or "restraints," a list of five approaches (see Table 2.2 , p. 26) for controlling negative habit patterns that diffuse energy in the individual and foster human discord. The yamas offer a concise approach to self-inspection. By identifying negative tendencies and fostering positive ones, practitioners can recognize underlying motivations that disrupt behavior. Thus, while at one level these restraints supply a set of ethical disciplines for practice, at a deeper level they are a tool for self-understanding, enabling practitioners to recognize the excessive attractions and aversions that so easily become ingrained in daily life.

The second rung of the ashtanga system is a list of observances (*niyamas*)—positive habit patterns that guide yoga practice. These principles form a framework that can be embraced at beginning levels as well as more advanced ones. For example, beginning students learn such techniques as nasal irrigation. Advancing students address purification of the mind. The practices associated with the five observances are multi-dimensional. *Svadhyaya* (self-study), for example, includes not only efforts to practice introspection but also the repetition of mantras, contemplation of philosophical ideals, and attention to teachings of accomplished teachers.

The remaining six rungs in the *ashtanga* system are composed of increasingly refined disciplines leading toward inner stillness. Patanjali famously defines the culmination of asana work as a posture that has become “steady and comfortable” (Bryant, 2009, p. 283). Breathing reaches its apex when it becomes a means for revealing inner awareness. And the senses, paradoxically, become a source of insight when they can be turned away from their objects and rested. Each of these stages of practice is itself a goal of yoga—each contributing to the awakening of a state of consciousness that transcends normal awareness.

The processes of yoga culminate in freedom from the wandering tendencies of the mind (Tigunait, 2014). This is achieved through the implementation of two interwoven practices: concentration and non-attachment. Together these lead an aspirant to self-mastery. Patanjali teaches that concentration practice bears fruit when it is continued over time and without interruption. But concentration is not, in this context, the result of labored attention. It is the outcome of resting awareness in a supportive focus, an *alambana* , and returning to that focus with regularity. With modest effort, periods of concentration become a natural part of daily life.

The companion to concentration, *vairagya* , or non-attachment, is a concept that has proved puzzling for Western students. In the West, attachment is generally considered to be a desirable thing, an indication of love and respect. These virtues, love and respect, are equally valued in yoga. But in yoga the term “attachment” is unrelated to qualities of endearment. Attachment is seen as an imbalance, a craving leading to sickness or to mental distraction. Non-attachment is its opposite, a sense of equanimity and emotional balance.

The highest state of meditation, and the eighth rung of the *ashtanga* system, is termed *samadhi* . It is described as a state of mental purity arising from one-pointed attention. In that state, consciousness is revealed as something more than a quality of mind. Consciousness is the nature of one’s being (Aranya, 1983).

The vedantic model of the self

Yoga is an inward journey, a centering movement within the human personality. The fifteenth-century text *Vedantasara* (The Essence of Vedanta), written by Sadananda, a monk in the Shankaracharya order, describes five layerings of human experience that surround the essential Self (Nikhilananda, 1931). These layerings act as covers, or sheaths (*koshas*), that veil pure consciousness. As yoga practice proceeds, each of these layers is gradually integrated and transcended.

The physical sheath, or anatomical level of existence (*annamaya kosha*)

The body is the most visible aspect of personality. It is the form consisting of food (*anna*), through which identity first shows itself. Despite the body’s substantial appearance it experiences continual change, shaped by four instinctive drives: the urges for food, sex, sleep, and self-preservation. Thus, working with diet, developing healthy sleep patterns, and cultivating periods of physical rest all function as important yogic lifestyle factors.

Six varieties of cleansing practices (*shat kriyas*) assist in maintaining physical health and well-being. They play an important role in the elimination of physical wastes (*mala shuddhi*) as well as the elimination of wastes accumulating at more subtle levels of functioning (*nadi shuddhi*). These six practices include *dhauti* (gastric cleansings), *basti* (colonic cleansings), *neti* (nasal cleansings), *nauli* (abdominal cleansings), *trataka* (gazing), and *kapalabhati* (cleansing of the energies of the skull) (Bhatt, 2004). It is important to remember that the *shat kriyas* are not simply physical cleansing techniques. They also utilize body mechanics to remove emotional and mental blockages. In the process of detoxifying, they allow positive, healing energies to flow. Thus, they serve as powerful synergists in the purification, activation, and regeneration of the body–mind.

Yoga postures, the focus of the third of Patanjali's eight limbs, are by far the most widely practiced techniques for managing the *annamaya kosha* . Practice of asana has evolved at a fast pace over the last half-century under the influence of a variety of teaching styles. Nonetheless, the core elements of posture work remain the same: sequenced variations of movement (*vinyasa krama*) leading to stillness in a prescribed pose, coordination of physical movements with the flow of the breath, and continuous mindfulness of breath and body. (See Box 2.2 .)

The sheath of vital energy, or physiological level of existence (*pranamaya kosha*)

Like iron filings influenced by a magnetic field, the body is said to be formed along lines of internal energy (*prana)* . The sheath consisting of this energy is internal to the physical body and is more subtle. It is often described as the interface between the body and mind—a force that holds the two together, thus sustaining and regulating life. Prana is not simply mechanical energy but a force that animates both body and mind. Every movement and thought is a demonstration of its presence. Access to the *pranamaya kosha* is through the breath, and its study is divided into two parts: breath training, which leads to full understanding of the basic mechanisms of breathing, and *pranayama* , the regulation and expansion of prana. (See Box 2.3 .)

The classical techniques of pranayama are powerful elements of practice and are represented in the fourth of Patanjali's eight limbs. Vyasa, Patanjali's commentator, has avowed that "there is no austerity superior *to* pranayama; it removes impurities and makes the light of knowledge shine*"* (Aranya, 1983, p. 243). Practice of pranayama magnifies awareness of the subtle dimensions of energy. For example, *nadi shodana* , an important practice of pranayama, brings attention to the shifting patterns of breath—the nasal cycle—flowing in the two nostrils. Throughout the day and night, the flow of breath in the nostrils shifts from one side to the other (Bhavanani, 2007). Regulation of this cycle is thought to have positive effects on mood and on various aspects of daily functioning.

Box 2.2 *Asana* – a functional classification

•**Cultural postures** :
  •postures for health and well-being, such as:
    •*bhujangasana* (cobra posture)
    •*shalabasana* (locust posture)
    •*dhanurasana* (bow posture)
•**Contemplative postures** :
  •postures for meditation, such as:
    •*padmasana* (lotus posture)
    •*sukhasana* (comfortable posture)
  •postures for relaxation, such as:
    •*shavasana* (corpse posture)
    •*makarasana* (crocodile posture)

Box 2.3 Classical *pranayama*
•*Surya bhedana* – sun-piercing breath •*Ujjayi* – the victorious breath •*Sitkari* – hissing breath •*Sitali* – beak tongue breath •*Bhastrika* – bellows breath •*Bhramari* – bee-sounding breath •*Murccha* – swooning breath •*Plavini* – floating breath

The flow of pranic energy is also regulated by the use of *mudras* and *bandhas* , neuromuscular seals and locks respectively. Hatha yoga mudras facilitate conscious control of energy by directing it to flow along the lines of energy channels (*nadis*). There are numerous gestures using the hands, feet, body, and head that enable conscious regulation of these psychophysical energies. In addition, three locks, the *bandhas–jalandhara* (jugular), *uddiyana* (abdominal), and *mula* (anal)—accompany the practice of certain pranayama techniques, preventing the uncontrolled elevation of pressure in the thoraco-abdomino-pelvic cavities. These locks are of great spiritual value also, since they help in facilitating the flow of energy along the spinal column and thus deepening meditation.

The conscious mind, or the psychological level of existence (*manomaya kosha*)

Subtler than the breath is the conscious mind (*manas*). It is the mental screen on which inner experience is projected. The *manomaya kosha* receives sense impressions from the outer world. It also acts as the coordinator of outer actions, making it possible to manipulate the world with one's hands, move about with one's feet, and communicate through the power of speech. It is the manomaya kosha that makes mental associations, brings memories to awareness, carries out thought processes, and presents objects of imagination to the self for its enjoyment. Thus, much of what we think of as human experience takes place on the screen of the conscious mind.

However, the functioning of this layer of the self is limited. For the most part, operation of the mind at this level is automatic and habitual. It is unable to arrive at a sense of value. Using the everyday mind we may be able to categorize events in the world with great sophistication, but we will not be able to determine their worth.

The seat of wisdom and discernment, or the intellectual level of existence (*vijnanamaya kosha*)

The short verb root “*vi-jna,* ” from which the name of the next kosha is derived, means “to discern, to know rightly, to understand.” As awareness deepens through concentration, it is possible to acquire a clearer and more accurate vision of one’s self and one’s relationships with the world. The practice of yoga, and in particular the practice of Patanjali’s first two limbs, helps to establish alignment with this vision. At the level of the vijnanamaya kosha it is not unusual to sense a subtle pulling away from the nervous excitement of the conscious mind toward a deeper and more peaceful state of awareness.

A distinct feature of yoga is the recognition that the human mind is an inner instrument. The mind provides experience (*bhoga*), as well as the peaceful revelation of consciousness (*apavarga*). The aspect of mind capable of discerning such states of consciousness is termed the *buddhi* , which may be translated as “awareness.” It is the functioning of the buddhi that is awakened through yoga relaxation and meditation methods. Through these practices, awareness is turned back upon itself, expanding, as we have seen, from a state of obscurity to one in which it witnesses body, breath, and everyday mental life. This leads, finally, to a state of “awareness of awareness itself” (Gitananda, 1976).

The sheath of bliss, or the universal level of existence (*anandamaya kosha*)

Enshrouded by the previous four coverings is the sheath named after the Sanskrit word for “rapture” or “bliss”: *ananda* . It is the most subtle aspect of personality and represents a state of consciousness well beyond the distractions of daily life. This is described as blissful because when meditation has progressed to a certain level of subtlety, the mind is said to reflect a sense of deep-seated and spontaneous joy or bliss (Nikhilananda, 1931).

Language can become an obstacle to experience at this stage. That fact has led to the practice of silence, which makes it possible to explore parts of experience that otherwise pass unacknowledged and unobserved. With this in mind, asana classes are often taught without a musical backdrop, instructions are carefully presented but kept to a minimum, and attention is shepherded to the quiet activity of self-observation (Anderson & Sovik, 2000).

The core of one’s being (*atman*)

The core of inner life is said to be beyond the reach of thought and words, yet it has been depicted and praised in many yogic texts. In the *Bhagavad Gita* , for example, it is said to be self-illuminating, the source of joy, and a state “unshaken even by heavy suffering” (Schweig, 2007, p. 97). In the *Katha Upanishad* it is described as “the life force that animates everything” (Tigunait, 2008, p. 129). And in the *Mundaka Upanishad* it is said that “the Self pervades the entire external and internal world … it is perfect and unalloyed” (Swami Rama, 1990, p. 83). Such examples reaffirm that the nature of yoga is to uncover an enduring core of health, peace, and well-being.

The practice of *tantra* yoga

Much of what is currently practiced in yoga classrooms, and described in contemporary yoga texts, is derived from the *tantric* tradition of yoga. Among *tantra's* central tenets is the notion that the body is not, as taught by more ascetical schools, an obstacle on the path to enlightenment (Goswami, 1999, p. xiii). In contrast with visions of spirituality that emphasize renunciation of life, early tantric adepts cultivated a positive physical awareness that later served as the source for the development of hatha yoga. The body was conceived of as an instrument for self-realization, and thus fully integrated into spiritual practice.

Tantra grew out of the principle that all the dimensions of life—the creative cycles of nature, the interplay of wildlife, the shifting climate, the powerful forces of galactic energies, the birth and sustenance of living beings, and the centrality of consciousness itself—are interconnected. To find one's place in this broad network of life experience one must look within and with an eye to the whole.

The interplay between mind and body is an example of the holistic nature of life. The understanding that mind and body influence each other and are not separable is increasingly permeating contemporary culture. For healing to take place in the functioning of one, it is necessary to seek balance and healing in the other.

Further, the forces that govern the operation of the universe are the same forces that govern the functioning of the individual. This is expressed in a well-known Sanskrit axiom, *yatha brahmande tatha pindande* —"that same reality which exists outside us as the macrocosm is present within us, the microcosm."

The essence of tantra is self-transformation. Practitioners seek to make changes within themselves in order to establish health, bring about a sense of self-empowerment, and awaken spiritual well-being. To do this, a practitioner of tantra makes use of energies already available (prana) to awaken energy lying dormant and unexpressed within (*kundalini*). While this is often described as "the awakening of kundalini," it might equally be articulated as the awakening of human potential and growth.

Among the methods used to cultivate such an awakening are many of the very tools we have previously encountered. Physical yoga (asana), pranayama exercises, sense withdrawal, concentration, contemplation and meditation all play central roles in the tantric model of practice. Indeed, both Patanjali and Shankaracharya were themselves fully acquainted with the tantric tradition. However, in addition to these, tantra integrates a wide variety of other practices, adding such tools as devotional expression, mantra science, ritual, and even the use of traditional herbs into the broad picture of yoga methodology.

It is perhaps necessary to mention that tantra has developed an association with sexual practices in some settings. Tantra, while not ignorant of sexual life, is far from interested in its mindless pursuit. Tantra offers a comprehensive vision of all dimensions of human life and spirituality.

The architecture of tantric practice

The tantric vision of human personality is organized around the alignment and distribution of inner energies. The central axis of these energies lies along the spinal column. Thus, the arms and legs serve as appendages, while the spinal column acts as the primary locus of attention. Tributaries of the central column of energy branch out to the complete body–mind complex. Neither the streams of energy (nadis) within the body nor the energies themselves can be seen. They act as subtle components of human functioning, experienced through yoga practice.

Where *nadis* , which are energy streams, intersect, they serve as the underlying support for physical structures and for glandular functioning. For example, *marma sthanas* , points of intersection, lie at the core of many joints. There they may become the focus of massage therapy, the center of attention in a series of yoga postures, or a locus of meditative concentration. (See Fig. 2.1 , p. xxix.)

The intersection of energies along the spine is of primary importance. These intersections are termed *chakras* . The word *chakra* means “wheel,” and each chakra, like a wheel, consists of various elements that function together. Consciousness serves as a hub, while psychological and physical structures surround it. These wheel-like vortices of energy along the spinal column act as avenues for self-awareness and anchor a wide variety of meditative practices.

The practical aim of tantra in regard to this system of energies is to awaken dormant potentials, said to be “sleeping” within. Awakening these dormant capacities while directing their energies for higher purposes is the goal of tantric practice. For example, energies resting at the base of the spine share the common theme of survival. Once “awakened,” they offer a sense of security and stability. Awakening is accomplished through a skillful combination of the practices already described.

Energies linked to the second chakra above the base of the spine share a more evolved theme. They evoke awareness of likes and dislikes, pleasures and related pains. One aim of practice at this level is the development of equanimity. And thus, in a similar way, awareness of each of the chakras, from the base of the spine to the crown of the head, calls for an integration of more primitive functioning and the development of creative and intuitive capabilities. (See Table 2.3 , p. 26.)

A tally of nadis is listed in the *Hatha Yoga Pradipika* as 72,000; in the *Prapanchasara Tantra* as 300,000; and in the *Shiva Samhita* as 350,000 (Saraswati, 1985). But the number of primary nadis ranges from just 10 to 14. Among these, it is agreed by all sources that three are of particular significance, spanning the length of the spine by weaving upward to end at the base of the nose, where the nostrils meet the upper lip. The nadi ending at the base of the right nostril is termed *pingala* and is associated with outward-moving, masculine energy. The nadi ending at the base of the left nostril is termed *ida* and is associated with inward-moving, feminine energy. The stream of energy ending at the base of the nose in the center is termed *sushumna* , meaning “joyous mind.” Thus when, through a highly evolved practice of yogic concentration, ida and pingala are united, the practitioner experiences great contentment and joy.

Schools of tantra yoga

We have already noted that tantra yoga practices overlap significantly with classical yoga. In particular, the internal practices of tantra revolve around the use of sounds called *mantras* . These sounds act as supports for meditation, harnessing distracting energies. The science of mantra is extensive and the repetition of mantras can form a central aspect of self-training. In addition, tantra has spawned a variety of other schools of practice. Kundalini yoga, svara yoga, mantra yoga, and laya yoga, as well as hatha yoga, all exist under the tantric umbrella.

Conclusion

The scope of yoga practice and its philosophical framework is much larger than most students realize in the beginning. This chapter has presented only the main themes of teachings that have emerged from many thousands of years of practice and exploration. Nonetheless, a glimpse is helpful. It offers support for the assertion that yoga's ability to enhance health and foster healing emerges from a deep and systematic understanding of human affairs.

There has been an enormous surge in the worldwide growth of yoga in the past few decades, and it is now a multi-billion dollar industry. Many of the popular approaches to yoga visible today are included in Table 2.4 (p. 27), which presents a list of styles and yoga schools found in the United States and in India.

As time passes, yoga is finding a broad audience. This is happening quite rapidly in the United States. A report from the National Center for Health Statistics notes that overall use of yoga among adults increased from 5.1% in 2002 to 9.5% in 2012 ($p < .05$), with use among adults 65 and over almost tripling (1.3% to 3.3%, respectively). Yoga use was most prevalent among adults 18 to 44, rising from 6.3% in 2002 to 11.2% in 2012 ($p < .05$) (Walker, 2015).

In an interview, Josephine Briggs, MD, director of the National Center for Complementary and Integrative Health (NCCIH), a division of the US National Institutes of Health, noted that health care trends typically tend to remain stable, so the rapid growth in yoga's popularity is especially noteworthy. Briggs suggested that the increased prevalence of yoga is likely due to its role in pain management (particularly musculoskeletal pain), an important area of awareness for health care providers (Walker, 2015).

The degree to which students of any approach validate it with their feet is important, for foot traffic is certainly one practical measure of the usefulness of a teaching. Another is the extent to which yoga philosophy and practice have been carefully examined and wisely fused. Finally, as this book illustrates, claims about yoga are also being investigated by controlled experiment and clinical observation. Since introspection and observation have long been the heart of yoga practice, perhaps these investigations will make it possible to envision a world in which wise use is made of the therapeutic tools of both East and West.

Table 2.1 The eight limbs of yoga

***Ashtanga yoga* — the eight limbs**		
1	***Yama***	**Restraints**
	Ahimsa	Non-harming
	Satya	Truthfulness
	Asteya	Non-stealing
	Brahmacharya	Control of lifestyle
	Aparigraha	Non-possessiveness
2	***Niyama***	**Observances**
	Shaucha	Purity
	Santosha	Contentment
	Tapas	Self-discipline
	Svadhyaya	Self-study
	Ishvara pranidhana	Trustful surrender
3	***Asana***	Steady posture
4	***Pranayama***	Expansion of vital energy
5	***Pratyahara***	Sensory withdrawal
6	***Dharana***	Concentration
7	***Dhyana***	Meditation
8	***Samadhi***	Self-realization

Table 2.2 Forms of yoga

Ashtanga yoga	The eight-limbed system outlined by Patanjali and forming the basis for all classic approaches to yoga practice
Hatha yoga	The initial stages of *ashtanga yoga* practice emphasizing right attitudes, asana, breath work, and relaxation
Raja yoga	The meditative stages of *ashtanga yoga* leading from resting the senses to deep states of relaxation, concentration and meditation
Karma yoga	A yogic path focusing on selflessness and non-attachment. A path that accompanies all other disciplines of practice
Bhakti yoga	A devotional path, often demonstrated through chant, poetry, ritual, pilgrimage and expressions of love for the Infinite
Jnana yoga	A path dedicated to philosophical clarity and self-observation. This approach integrates self-analysis and meditation
Tantra yoga	A highly integrated, holistic path; the umbrella for much of the practice now taught in yoga classes and depicted in yoga texts
Mantra yoga	An approach emphasizing the use of internal *mantric* sounds for mental support and the refinement of awareness
Kundalini yoga	A path dedicated to arousing dormant spiritual energy (*kundalini*) and directing it upward along the spinal axis
Laya yoga	A method contributing to kundalini awakening through the systematic integration of lower energies into higher ones
Svara yoga	An advanced yoga practice dedicated to the study of *pranic* rhythms and internal paths of energy

Table 2.3 *Chakras* and their correlations in the human body

Chakra	Centre	Petals	Physical	Plexus	Endocrine gland	Qualities
Muladhara	Root support lotus	4	Base of spine	Sacral	Gonads	Integration, solidarity, cohesiveness
Swadhisthana	Lotus of one's own abode	6	Pelvis	Hypogastric	Adrenals	Flexibility, diplomacy, equanimity
Manipura	Gem city lotus	10	Navel	Solar	Pancreas	Power, passion, motivation
Anahata	Lotus of unstruck sound	12	Heart	Cardiac	Thymus	Compassion, tolerance, understanding
Vishuddha	Throat/purity	16	Throat	Pharyngeal	Thyroid	Freedom, communication
Ajna	Brow/intuition	2	Brow	Cavernous	Pituitary	Wisdom, intuition
Sahasrara	Crown	1000	Top of the head	Coronal	Pineal	Transcendence

Table 2.4 Styles and schools of yoga		
Yoga style/school	**Key characteristics**	**Related URLs**
Ananda yoga	A system of *hatha yoga* established by Swami Kriyananda, a disciple of Paramahansa Yogananda, and based on his *Kriya yoga* teachings. Emphasizes self-awareness and *pranayama* , enhanced by initiation	www.ananda.org
Anusara yoga	A school of yoga oriented around tantric teachings. *Hatha* poses are developed from a creative and devotional inner feeling. Principles of alignment underlie postures and connect to spiritual growth	www.anusarayoga.com
Ashtanga yoga	A *Hatha yoga* system taught by Sri K. Pattabhi Jois (1915–2009). It involves synchronizing the breath with a series of postures—producing intense heat, detoxification, a light, strong body and calm mind	www.ashtanga.com
Bihar School of Yoga (India)	The Bihar School of Yoga has been the source of many modern publications, translating essential yoga texts. Its teachings and practice focus on the integration of *Vedantic, tantric* , and yogic practice	www.biharyoga.net
Bikram yoga	A system of 26 *Hatha yoga* postures selected and sequenced by Bikram Choudhury and practiced in a heated room. Heat is supplied in order to soften body tissues and prepare them for purification	www.bikramyoga.com
Gitananda yoga (India)	Also called "*Rishiculture Ashtanga yoga* ," this school was founded by Dr Swami Gitananda Giri. While including the full range of classical yoga practice, it gives special emphasis to *mantra, tantra* , and *yantra*	www.rishiculture.org
Hatha yoga	A large number of yoga studios and schools function without particular school affiliation or branding. The	

	primary form of yoga they teach is hatha yoga, drawing on teachings from a variety of sources, and ranging from gentle to challenging	
Himalayan Institute yoga	A school directly linked to the meditative traditions of yoga and *tantra* . Emphasizes Patanjali’s eight-fold path along with the development of a thorough integration of yoga philosophy and practice	www.himalayaninstitute.org www.yogainternational.com
Integral yoga (Sri Aurobindo) (India)	Focused on the teachings of noted twentieth-century Indian philosopher Sri Aurobindo. Dedicated to the integration of one’s lower and higher natures through meditation and daily action	www.auroville.org www.miraura.org
Integral yoga	Following the teachings and inspiration of Swami Satchidananda, students of this school integrate six forms of yoga: *hatha, raja, bhakti, karma, jnana* , and *japa* (repetition of *mantra*)	www.yogaville.org
Iyengar yoga	Based on the teaching of Sri B.K.S. Iyengar, this practice style emphasizes precision and alignment. A variety of props assist in making postures accessible. Careful sequencing of postures is cultivated	www.bksiyengar.com
Jivamukti yoga	A vigorous, *vinyasa* -based hatha yoga style with mindful adherence to five tenets: *shastra* (scripture), *bhakti* (devotion), *ahimsa* (non-harming), *naada* (music), and *dhyana* (meditation)	www.jivamukti.com
Kripalu yoga	Distinguished by an emphasis on bringing awareness to the physical sensations, emotions, and thoughts that arise in practice. Kripalu teachers describe this as “inquiry-based” learning	www.kripalu.org
Kundalini yoga (3HO)	A vigorous practice dedicated to spiritual awakening through the active integration of a wide	www.3ho.org/kundalini-yoga

	variety of yoga techniques. Known for integrating posture work with pranayama and mantra	
Kuvalayananda/Kaivalyadhama (India)	A research institute, Kaivalyadhama, founded in 1924 by Swami Kuvalayananda. He envisioned bringing modern science and traditional yoga together. Now contains a college, hospital, and a research facility	www.kdham.com
Patanjali yoga (India)	Patanjali yoga promotes the spread of yoga through the work of Swami Ramdev, a leading Indian teacher. The organization has reached most parts of India. It includes a university, a hospital, a training center, and research facility	www.divyayoga.com
Power yoga	A vigorous, fitness-based practice of *Hatha yoga* . Drawn from the teachings of Patabhi Jois, it focuses on flexibility and strength. Class sequences vary and have been imported into a variety of fitness settings	
Self-realization fellowship	SRF is an organization founded by Paramahansa Yogananda to convey the teachings of *Kriya yoga* . It offers a meditative path, taught in four steps, combining pranayama, mantra, and initiation	www.yogananda-srf.org
Sivananda yoga	Begins with a traditional, slow-paced, meditative class that helps encourage proper breathing, flexibility, strength, and vitality in the body while calming the mind	www.sivananda.org
S-VYASA (India)	Swami Vivekananda Yoga Anusandhana Samsthana (founded in 1970s) is a yoga university (2002) promoting the four-fold message of Swami Vivekananda: *karma, bhakti, jnana* , and *raja* yoga. It also includes a hospital and research facility	www.svyasa.edu.in
Viniyoga	A therapeutic approach that adapts methods of practice	www.viniyoga.com

	according to the unique condition, needs, and interests of each individual. A gentle practice tailored to a student's changing condition
Vinyasa yoga	Traditionally, *vinyasa* practice is distinguished by its attention to transitions, both within an individual posture and in posture sequences. *Vinyasa* yoga is now identified with vigorous styles of practice
Other Western styles and teachers	Agni yoga; Anahata yoga; Amrit yoga (Amrit Desai); Dru yoga; Forrest yoga (Ana Forrest); Hot yoga; ISHTA yoga (Alan Finger); Kriya yoga; Para yoga (Rod Stryker); Prana Flow yoga (Shiva Rae); Restorative yoga; Samatva yoga; Sampoorna yoga (Yogi Hari); Shanti yoga; Shiva yoga; Siddha yoga; Svaroopa yoga (Swami Nirmalananda); Triyoga (Kali Ray); White Lotus yoga (Tracey Rich and Ganga White); Yin yoga; Mount Madonna Center (Baba Hari Dass)
Other Indian schools of yoga	Art of Living Foundation; Isha Institute of Inner Sciences; Dev Sanskriti Vishwavidyalaya; The Divine Life Society; Himalayan Institute Hospital Trust; The International Centre for Yoga Education and Research; Isha Foundation; Krishnamacharya Yoga Mandiram; Sannidhi of Krishnamacharya Yoga; Morarji Desai National Institute of Yoga; Sri Ramakrishna Math and Ramakrishna Mission; The Yoga Institute, Santacruz; Vipassana International Academy

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CHAPTER THREE

HISTORY, PHILOSOPHY, AND PRACTICE OF YOGA THERAPY

T MCCALL • L SATISH • S TIWARI

The precise origins of yoga therapy have been lost in the mists of time, and there is debate among scholars about exactly how old it is. Although yoga itself is thousands of years old, and its effects on health and well-being must have been apparent to ancient practitioners, some believe that yoga therapy is largely a twentieth-century invention.

Yoga therapy (*yoga citiksa*) is not a term used in historical texts, and most texts do not focus on yoga as a therapy per se. Traditionally, yoga was seen as a spiritual path, a methodology to achieve transcendence from the limitations of the ego and free oneself from suffering, not as a means to better health. But Patanjali, in the classical text the *Yoga Sutras,* dated to the early common era, listed disease as one of the impediments to spiritual practice. It seems likely then that yogis would have employed various yogic tools, from chanting to meditation to yoga poses (*asana*), in an effort to overcome the limiting effects of disease on carrying out an intense spiritual practice.

Yogis would also have likely relied on the traditional holistic system of medicine in ancient India, ayurveda, which can be translated as the “science of longevity.” Ayurveda, itself also thousands of years old, is considered by many yoga practitioners to be the “sister science” to yoga, in part because both systems share the intellectual underpinning of *Sankhya* philosophy. Many modern yoga therapists incorporate ayurvedic principles into their work, and they believe it allows greater subtlety and personalization of therapeutic approaches for individual patients.

The first textual evidence for what could be considered yoga therapy appears in the *Hatha Pradipika* (often referred to as the *Hatha Yoga Pradipika*) written circa 1350 ce by Svatmarama (Digambaraji & Kokaje, 1998). It is clear that an ayurvedic perspective and an awareness of the health effects of various yogic tools have been incorporated into this yoga practice handbook. Consider this description of the effects of a pose:

> Mayurasana *quick destroys all tumors and diseases of the spleen and the stomach, wards off disorders of doshas (Ayurvedic humors), stokes the digestive fire, and completely digests unwholesome food, even poison* .
>
> (Digambaraji & Kokaje, 1998, I.31)

And this description of a *pranayama* technique:

> *This excellent practice,* Surya Bhedhana*, should be practiced again and again. It cleanses the frontal sinuses, eliminates disorders caused by vata dosha and diseases caused by intestinal worms.*
>
> (Digambaraji & Kokaje, 1998, II.50)

In particular, the recently unearthed fifth chapter of the *Hatha Pradipika* , published by Kaivalyadhama Samiti (Digambaraji & Kokaje, 1998), shows evidence of an understanding of the therapeutic potential of yoga as an adjunct to medical care:

> *In all diseases, a yogic patient should take treatment from a physician and also use yogic treatments.*

(Digambaraji & Kokaje, 1998, V.22)

The history of yoga therapy in modern India

Over the centuries, people continued to practice yoga, but it was in marked decline during the British occupation of India. However, a modern renaissance of yoga started in the 1920s, in part tied to efforts to foster an indigenous Indian form of exercise for maintaining health and well-being. This was a time of growing Indian nationalism, when forms of exercise from foreign lands, such as bodybuilding and European styles of gymnastics, were gaining in popularity among middle-class Indians (Singleton, 2010).

In the early 1920s, an educator named Jagannath Ganesh Gune, later known as Swami Kuvalayananda (see Fig. 3.1), began to investigate such yogic practices as *uddiyana bandha* , using X-rays and other medical equipment (see Figs 3.2 and 3.3). This and other research was later published in *Yoga Mimamsa* , the first research journal devoted to yoga, which he founded. In 1924, Gune set up the Kaivalyadhama Yoga Institute in the western part of India in the state of Maharashtra, in a town called Lonavla (Alter, 2004).

Also in 1924, Kuvalayananda established the *Rugna Seva Mandir* (Temple of Healing Disease) at Lonavla, where the aim was to manage medical conditions through the application of yoga therapy. In 1932, he established a dedicated yoga therapy clinic for residents of Mumbai (then known as Bombay). In both of these clinics, the approach to yoga therapy was to teach it one-on-one. Kuvalayananda personally wrote a “case paper” for each individual, and each was taught a personalized program. In 1961, a 50-bed hospital was started at Lonavla, where people could avail themselves of yoga therapy on a residential basis, led by a team of physicians and yoga teachers.

Figure 3.1
Experiment on *pranayama* at the Kaivalyadhama Yoga Institute (1958), overseen by Swami Kuvalayananda (left).
Reproduced with permission from K. S. M. Y. M. Samiti, India

Figure 3.2
Subject in an experiment to study differences between the state of *samadhi* (yogic absorption) and hypnosis at Kaivalyadhama, circa 1952.
Reproduced with permission from K. S. M. Y. M. Samiti, India

Nearby, also in Mumbai, The Yoga Institute was established in 1918 by Sri Yogendra (also known as Manibhai Haribhai Desai) to investigate the health benefits of yoga and to propagate yoga as a form of exercise indigenous to India. Yogendra was a student of Swami Madhavdas, who was also the guru of Swami Kuvalayananda. Originally a proponent of gymnastics, wrestling, and other forms of exercise, Yogendra offered simplified asana and pranayama accessible to householders rather than yoga as a practice solely for renunciates. His desire was to make yoga more scientific, more democratic, and safer and, unlike the yoga of the traveling hatha yogis he had met early in his life, less cultish and shrouded in secrecy (Singleton, 2010).

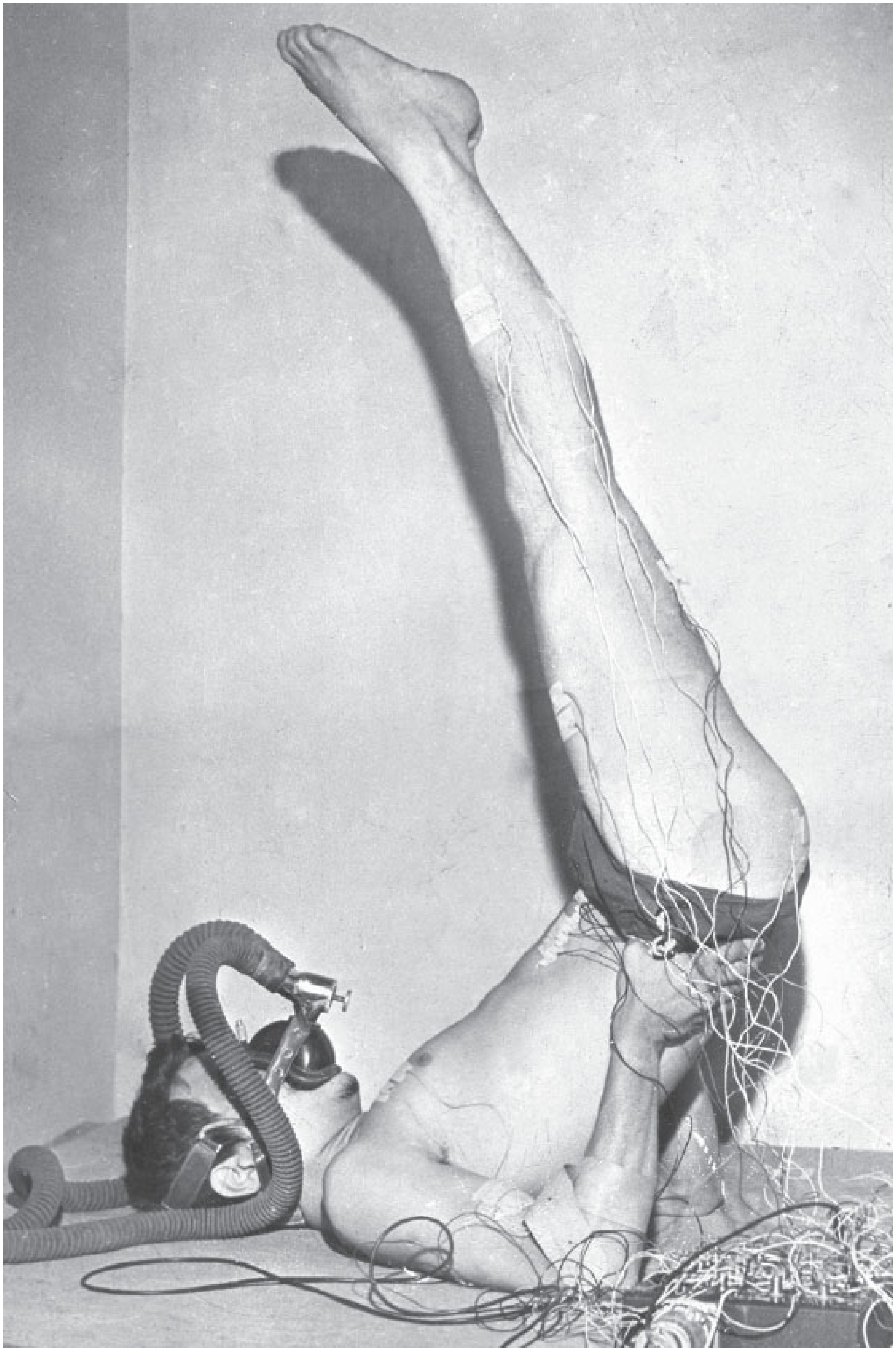

Figure 3.3
Experiment on oxygen consumption during *sarvangasana* (shoulderstand) at Kaivalyadhama, circa 1965.
Reproduced with permission from K. S. M. Y. M. Samiti, India

Yogendra wrote popular books on yoga and offered general classes, open to men and women of all castes (a first) and to people with various health conditions. Although he did not describe what he taught as yoga therapy, he emphasized that yoga could improve health and well-being and reduce symptoms of illness. The Institute, now located in the Mumbai suburb of Santacruz, continues to offer classes and is involved in yoga research and teacher training.

A contemporary of Kuvalayananda and Yogendra, Tirumalai Krishnamacharya (1888–1989) began teaching yoga in the south of India, in Mysore, around the same time. Trained in yoga from a young age, he had studied all six traditional philosophical systems of ancient Vedic knowledge and was a Sanskrit scholar as well as an expert in ayurveda. From 1914 to 1919, he studied yoga and yoga therapy intensively with a master practitioner, Ramamohan Brahmachari, who lived in a cave in Tibet.

After returning to Mysore, in 1924 Krishnamacharya became a patron of the Maharaja of Mysore, Krishnaraja Wodejar, who had heard of his reputation as a yoga therapist and gave him a wing of the Jaganmohan Palace to teach in. The Maharaja suffered from diabetes, infertility, and other health problems, which neither European doctors nor local healers had been able to help with much. Under Krishnamacharya's treatment with yoga, diet, and herbal medicines, however, the Maharaja began to improve rapidly. In subsequent years, he dispatched Krishnamacharya far and wide to lecture on yoga to large audiences. Information on the therapeutic effects of yoga and patient testimonials were often included in his talks. Impressive demonstrations by his most advanced students, including a teenaged B. K. S. Iyengar, helped build the popularity of yoga in India (Desikachar & Cravens, 2005; Sjoman, 1996).

Krishnamacharya taught the boys of the palace, relatives on the maternal side of the royal family, a gymnastic-style yoga practice that became the basis for the modern Ashtanga Yoga, popularized by his pupil Pattabhi Jois (see Figs 3.4 and 3.5). Although Krishnamacharya mostly taught group classes, he would also teach people with health problems separately and incorporate modifications and variations to suit their individual needs. After Indian independence in 1947, he moved to Chennai (at that time known as Madras), where he focused on yoga therapy, particularly in tailoring yoga practices to meet the specific needs of individuals with various health conditions. Krishnamacharya is widely known today due to the fame of a few of his disciples, including Jois; his son, T. K. V. Desikachar; and especially his brother-in-law, B. K. S. Iyengar. In 1976, Desikachar founded the Krishnamacharya Yoga Mandiram in Chennai, which continues his father’s therapeutic work.

B. K. S. Iyengar (see Fig. 3.6) began to study yoga with Krishnamacharya in Mysore in 1934, at the age of 15, in order to improve his chronically poor health. Iyengar was weakened by the 1918 influenza pandemic, tuberculosis, malaria, and other health problems, but he became markedly stronger as a result of his yoga practice, and in the process, he found his life’s calling. At Krishnamacharya’s suggestion, in 1937 Iyengar moved to Pune, in Maharashastra, to teach yoga.

In 1954, Iyengar met the famous violinist Yehudi Menuhin and used yoga to help him recover from tendonitis in one hand (Desikachar, 1998). Believing that yoga had also improved his violin playing, Menuhin brought Iyengar to the West and wrote the introduction to Iyengar’s 1966 magnum opus, *Light on Yoga* . The book went on to sell millions of copies and catapulted Iyengar to worldwide fame. In the back of the book, Iyengar recommended specific poses for different health conditions, though in his own therapeutic work, he always tailored his prescriptions to each individual. Iyengar went on to establish The Ramamani Iyengar Memorial Yoga Institute in Pune in 1975, where he continued to teach until shortly before his death in 2014. Medical classes, in which people with a wide variety of health conditions are treated on an individualized basis, continue to be part of the Institute’s offerings.

Among Iyengar’s innovations was the use of props such as blankets, bolsters, and blocks to enable an individual to attain otherwise unavailable postures. He also pioneered “restorative yoga,” supported poses in which props are used to hold the body in yoga poses with minimal or no effort. Restorative poses are used extensively by many modern yoga therapists. In addition, Iyengar was the first yoga practitioner to stress the importance of standing poses such as triangle pose in asana practice.

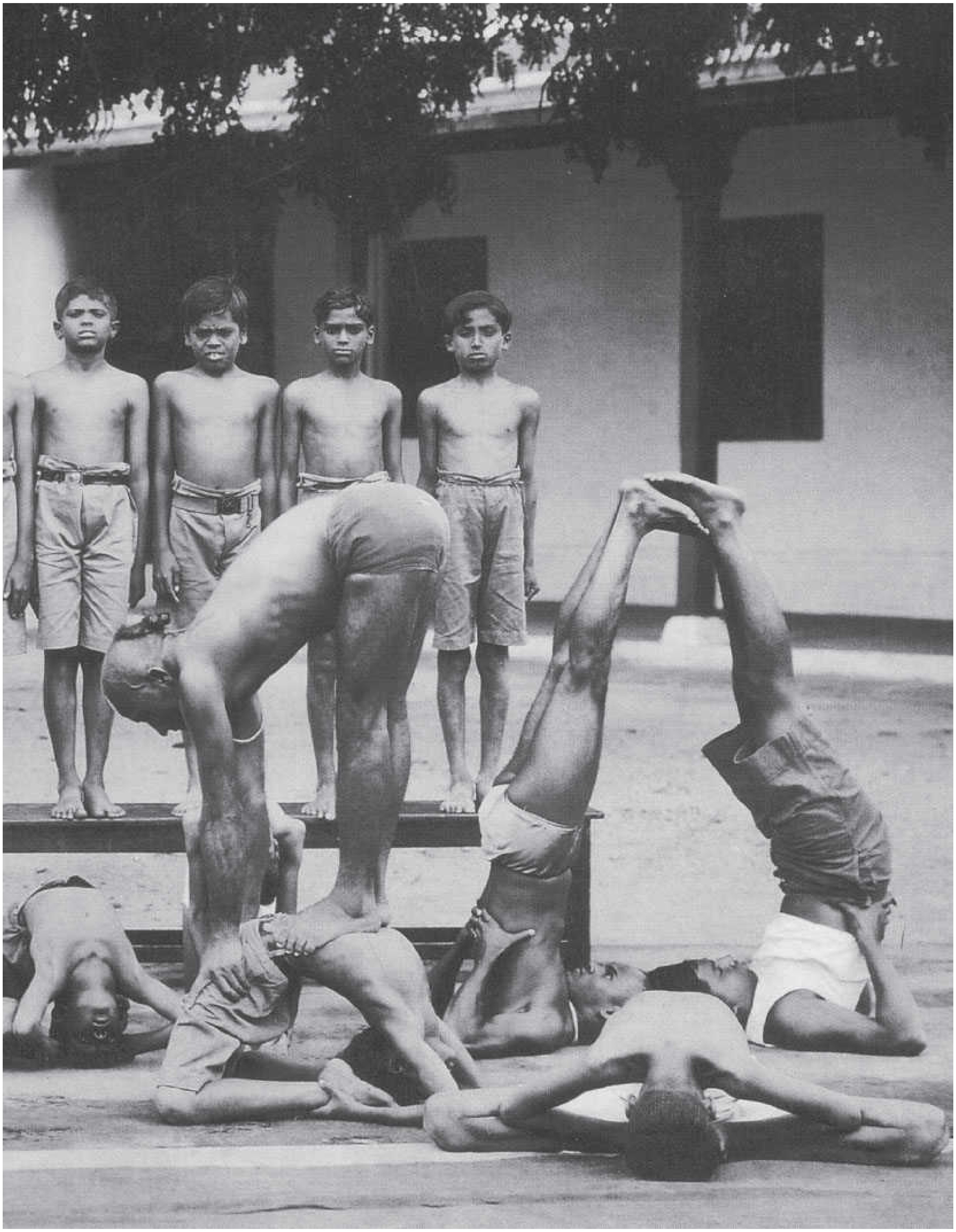

Figure 3.4

T. Krishnamacharya (left, standing on a student) with students at Jaganmohan Palace, Mysore, 1934.

In 1964, a disciple of Swami Sivananda of Rishikesh, Swami Satyananda founded the Bihar School of Yoga (BSY). Though fundamentally involved in teaching traditional yoga to both householders and renunciates, the school raised awareness of yoga's therapeutic potential by focusing its teaching and publications on the effects of yoga practices on psychological and physical health. BSY still trains teachers and publishes numerous books, some on yoga therapy. Two other of Sivananda's disciples, Swami Vishnu Devananda and Swami Satchidananda, emigrated to the West and started prominent schools of yoga, Sivananda Yoga and Integral Yoga, respectively.

Swami Gitananda Giri was born in 1907 in northern India to an Irish mother and a Sindhi father. He studied medicine in England, later emigrated to Canada, and returned to India in 1967. In 1972, he established the Ananda Ashram, Pondicherry (now known as Puducherry). In 1993, the year of Gitananda's death, the Center for Yoga Therapy Education & Research (CYTER) opened at the Mahatma Gandhi Medical College in Puducherry. CYTER delivers individualized yoga therapy to patients either one-on-one or in small groups, integrated into their allopathic treatments. In addition, CYTER is involved in yoga therapy research; educates hospital staff members, including physicians and nurses; and conducts postgraduate education of yoga therapists to work in hospital settings.

Figure 3.5
T. Krishnamacharya at age 100 (1988).
Reproduced with permission from Krishnamacharya Yoga Mandiram, Chennai, India

In 1986, the Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA) was established near Bangalore (now known as Bengaluru) to conduct scientific research on yoga and deliver yoga therapy. SVYASA continues to be actively involved in practicing yoga therapy, under the direction of physician R. Nagarathna, with a residential campus housing 250 patients. SVYASA scientists continue to actively study yoga and yoga therapy, and they have published more than

250 scientific articles in peer-reviewed Indian and Western scientific journals. SVYASA also trains large numbers of yoga teachers, yoga therapists, and yoga scholars in a wide array of degree programs, including doctorates in yoga.

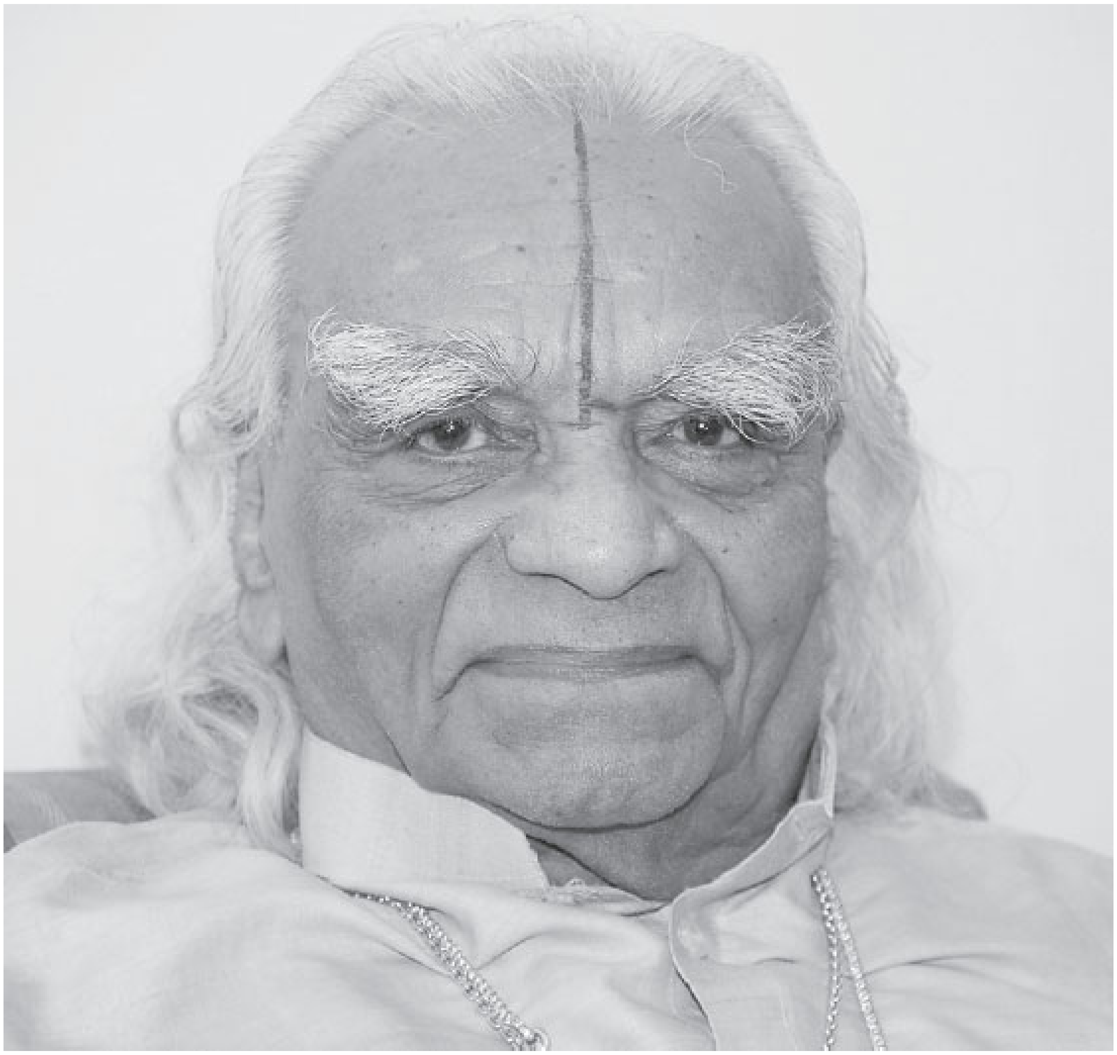

Figure 3.6
B. K. S. Iyengar, c. 2006.
Reproduced with permission from K. S. M. Y. M. Samiti, India

Modern-day gurus with millions of followers have shown interest in scientific investigation of the therapeutic potential of yoga. These include Swami Ramdev of Hardiwar, who gained fame via a television program aired throughout India, and Sri Sri Ravi Shankar of Bangalore, a one-time disciple of Maharishi Mahesh Yogi, the inventor of Transcendental Meditation (TM), who developed his own proprietary set of breathing techniques known as Sudarshan Kriya Yoga.

The Indian government's Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha and Homeopathy) oversees planning, promotion, and coordination of yoga education, training, therapy, and research. Begun in 1995, it has started four Advanced Centres for Yoga Therapy & Research to encourage established hospitals to work in the field of yoga therapy. In addition, AYUSH sponsors continuing medical education in yoga for physicians.

Yoga therapy in the West

Although yoga has been taught in the United States since the early twentieth century, it gained popularity in the 1970s and underwent another surge of interest starting in the late 1990s. A 2008 *Yoga Journal* survey of 5,000 Americans found that the number of practitioners had increased by 87% compared to the previous survey in 2004, representing about 15.8 million people nationally (Yoga Journal Releases 2008 'Yoga in America' Market Study: http://www.prnewswire.com/news-releases/yoga-journal-releases-2008-yoga-in-america-market-study-57146512.html). That number has increased to 20.4 million in 2012 and then to 36.7 million in the most recent *Yoga Journal* and Yoga Alliance survey in 2016 (https://www.yogaalliance.org/2016YogaInAmericaStudy).

Initially, yoga was used as a relaxation method in the West, and for those who were drawn to it, a spiritual path. With the growth of the alternative medicine movement in the United States and other Western countries, interest grew in the health benefits of yoga practice. Of note, the 2008 *Yoga*

Journal survey found that "almost half (49.4 percent) of current practitioners started practicing yoga to improve their overall health. In the 2003 study, that number was 5.6 percent." In addition, "6.1 percent, or nearly 14 million Americans, say that a doctor or therapist has recommended yoga to them."

Starting in the 1980s, yoga therapy grew in the West as well as in India, in part due to scientific research (undertaken both in India and, increasingly, in the West) that began to document some of the practice's purported health benefits. This was the advent of Dr Dean Ornish's Program for Reversing Heart Disease, which became one of the first evidence-based programs that used yoga as part of a therapeutic intervention to address a specific pathology (it is noteworthy that the word "yoga" never appeared in the first study Ornish published in *JAMA,* but was referred to as "stress-management training" Ornish et al., 1993). Indeed, it was the scientific evidence that led the US government's Medicare program in 2012 to approve the Ornish program for intensive cardiac rehabilitation (Medicare covers yoga for heart disease: http://www.cnn.com/2012/02/25/health/medicare-covers-yoga-heart-disease/).

Through the 1990s and into the new millennium, hundreds of studies were conducted on the effects of yoga as a therapeutic tool for a wide range of medical conditions, with research increasingly finding its way into respected peer-reviewed journals. And though the methodology of early yoga research was suboptimal, the quality improved greatly from 1980 going forward, with many more randomized controlled trials published in both India and the West. In 2006, the *International Journal of Yoga Therapy* (IJYT), a publication of the International Association of Yoga

Therapists (IAYT), became peer-reviewed. In 2011, IJYT began to be indexed in PubMed, the database of the National Library of Medicine.

Arguably the most influential yogi in shaping the development of yoga therapy in the West (albeit indirectly) was T. Krishnamacharya. His students, T. K. V. Desikachar and B. K. S. Iyengar, did much to put yoga therapy on the map in the United States and Europe. A handful of Indian yoga teachers who took up residence in the West, including Yogi Bhajan in New Mexico and Swami Satchidananda in Virginia, encouraged therapeutic applications of traditional yoga practices.

Many yoga therapists in the West have also been influenced in their approach by training in other health care fields, both alternative and conventional. These include medicine, nursing, psychology, physical therapy, massage and other forms of bodywork, and such modalities as ayurveda, traditional Chinese medicine, Feldenkrais, and the Alexander Technique. Many modern yoga therapists also have backgrounds in such disciples as neuroscience, anatomy, kinesiology, dance, and martial arts such as qi gong, any of which may influence how they practice yoga therapy. In addition, many Western yoga practitioners and yoga therapists have been influenced by Buddhist teachings (or secular versions of the teachings, such as Mindfulness-Based Stress Reduction), including a Buddhist understanding of psychology and various meditation techniques, which they incorporate into their therapeutic approach.

Yoga versus yoga therapy

Although yoga has been demonstrated to have numerous health benefits, and various protocols have proven helpful for people with a variety of health conditions, not all yoga is appropriate for all patients. Indeed, with the growing popularity of a fitness and performance orientation in some modern styles of yoga (and their attendant risk of injury), especially in the West, it is important to understand that yoga therapy is different from simply taking a yoga class.

Yoga classes are generally “one size fits all,” that is, the same set of practices is given to each practitioner with the objective of lowering stress, enhancing flexibility, stamina, strength, and mental calmness or focus. In group classes, the teacher is often unaware of the students’ relevant health information, though many teachers make a point of asking, and some will suggest pose modifications or substitutions for some students. However, yoga was traditionally taught by masters to motivated seekers in a guru–disciple relationship, with the practice tailored to the individual’s specific situation. It should be noted, therefore, that the group yoga class appears to be a twentieth-century invention.

Holistically seen, no two people are identical, and thus in the clinical practice of yoga therapy, the prescribed practices vary, including among people with identical diagnoses. Even people with the same condition, say breast cancer, may vary in disease severity, their stage of treatment, and the amount of time they can devote to their yoga practice, as well as varying in comorbid conditions. People also have different strengths and weaknesses; different degrees of overall health, fitness, and psychological well-being; and different levels of experience in yoga. Each of these factors can affect which practices the therapist will recommend, and often more importantly, which ones they will *not* recommend.

In yoga therapy, traditional practices of asana, pranayama, chanting, meditation, visualization, and so on are modified, adapted and/or simplified to suit the capacity and needs of individual patients. Yoga therapy can be used for symptom alleviation, rehabilitation, and as preventive medicine. Spiritual growth may be part of this, but it does not need to be included in the treatment plan.

Whether the focus of practice is on yoga for therapy or general health promotion, the basic tenets are derived from yoga philosophy and traditional yoga practices. *Ahimsa* , the yogic precept of nonharming, is the foundation of yoga therapy, and therapists strive, above all, to avoid causing harm. Some students may start yoga for therapeutic purposes (in a class or yoga therapy setting) and broaden their interest over time, for example, wanting to pursue the spiritual dimensions of the practice. On the other hand, a student who begins a yoga journey as an ardent seeker may modify practices because of health concerns. Thus these streams may overlap, and students may practice with different goals at different times.

The practice of yoga therapy

Much of modern yoga therapy is practiced via one-on-one consultations. However, unlike most other health care modalities, yoga therapy can also be provided in group settings, where the group participants have a similar condition and/or seek similar therapeutic outcomes. Sometimes, a yoga therapist will evaluate the client and prescribe a therapeutic routine in a one-on-one setting, but perhaps due to the student’s financial situation or some other reason, then encourage follow-up in a group class (ideally one with an experienced teacher who can modify the routine being taught to the rest of the class for that student if necessary).

Yoga therapy, unlike a general yoga class, starts with the client providing a history and receiving a health assessment from the practitioner. This health assessment shares some of the methods of Western approaches to mind–body medicine but also includes methods that derive from yoga’s particular understanding of physical structure, the breath, and other aspects of the mind and body as well as taking into account the client’s social environment.

In one-on-one settings, the level of assessment can be quite detailed, allowing for a tailored treatment plan to suit the client. However, in group yoga therapy sessions, the level of assessment is generally limited and the treatment plan less tailored to each client. Follow-up appointments in yoga therapy are typically as agreed to by the practitioner and client, much as in other areas of health care.

Of note, virtually all of the scientific studies of yoga therapy base their assessments on group yoga therapy sessions using standardized protocols based on the medical diagnosis (or often in sicker patients, just one of their diagnoses). Numerous studies have demonstrated benefits from these practices, as detailed throughout this book. Due to the lack of personalization, however, most yoga therapists consider all such standardized methods inferior to individualized yoga therapy, but so far this belief has not been subjected to scientific scrutiny. Indeed, governmental and private funders generally refuse to fund anything other than studies of standardized yoga protocols.

Yoga therapy is more about self-care than the yoga therapist “doing something” to the client to effect change. Yoga therapy empowers clients to care for themselves through carefully planned mind–body exercises and changes in lifestyle. In order to effect sustainable improvements in their health, clients must undertake the recommended practices on a regular basis, ideally every day. Beyond physical health, yoga offers the possibility of spiritual growth, a reduction of suffering, and finding a sense of meaning in life.

An important characteristic of many therapeutic applications of yoga is the modifications, simplifications, and integration of various yogic tools. Some yoga traditions, for example, employ props such as blocks, straps, and bolsters to render otherwise difficult or impossible practices manageable. This is done to optimize therapeutic effectiveness, as well as safety. Yoga therapy may involve an integration of many yogic tools or a combination of a few. For example, the therapist may provide lifestyle recommendations, a structured sequence of postures to be practiced, breath-regulation techniques, visualizations, and more. Some yoga therapists in the West, however, restrict their domain to structural issues, using mostly asana to effect change.

While conventional medicine tends to think in terms of “active ingredients,” in yoga therapy, it usually will not be a single asana or single meditation practice that works for the individual. Each component of a practice may have an independent impact or contribute to the overall impact (it is also possible that some components may not work at all, even if the overall program does). Although rapid improvements sometimes occur, usually the process is stepwise and gradual over months and even years. Unfortunately, almost all yoga research to date has been shorter-term studies—weeks to months—and may therefore have underestimated the value of the practice.

The yoga therapist’s duties include developing a practice for the client, usually to be done at home; motivating the client to practice; providing instructions; making observations of the client’s practice quality; and providing feedback at the initial and subsequent sessions. Vital to success, from a yogic perspective, is the regularity of the student’s practice.

Changing samskaras

Much of the focus in yoga therapy is on getting the client to recognize and modify attitudes and behaviors that may contribute to ill health. In Sanskrit, a habit of thought, word, or deed is called a *samskara* . Taking advantage of neuroplasticity, yoga therapists try to develop yoga practices for their students that can help to establish new habit patterns. Through regular practice, these new habit patterns become increasingly stronger, new neural networks are forged and strengthened, and eventually the new samskaras may be able to out-compete the old dysfunctional ones. This is the crucial methodology used in yoga therapy to change even long-term bad habits.

Bad habits may be postural, such as when people round their backs when they sit or stand, or dysfunctional habits may involve unhealthy food choices, poor breathing, a lack of exercise, self-defeating attitudes, experiencing a feeling of lack of meaning in life, and so on. Even how reactive one's autonomic nervous system is to a stressor, real or perceived, can be thought of as a samskara that can potentially be changed.

Thus, identifying dysfunctional samskaras of body, mind, and spirit, and then developing a program to allow the student to start replacing them with healthier samskaras, is the central work of the yoga therapist. It is recognized in yoga that students will sometimes have unhealthy habits that they may not currently be able to change. Still, helping the client see them clearly (when he or she is ready to hear it) is felt by yoga therapists to be an important step toward the client perhaps eventually making lasting change.

According to the yoga tradition, the best way to develop samskaras that become powerful enough to replace old samskaras is to practice the new pattern every day, even if only for a little while. A daily 10-minute practice, for example, may yield much greater benefits than a longer practice done once or twice a week. Regular practice over a long period of time without interruption was Patanjali's formula for success in yoga (Bryant, 2009).

For most people, doing a yoga therapy practice at home is the best way to achieve regularity, particularly in light of how busy so many clients are and how little time they can carve out of their schedules. However, once people start to practice regularly and begin to feel the benefits, this can become the motivation to continue.

The yoga therapist's evaluation includes determining as many of the student's imbalances as possible in order to ascertain how to re-pattern the samskaras. If the client's posture is poor, the yoga therapist may prescribe asanas to help change it. If the breath is shallow or rough, the therapist might work to retrain the person to breathe more efficiently and deeply. If the person has high psychological stressors, the therapist might include work to calm the autonomic nervous system, choosing from a wide variety of possible yogic tools. If a client lacks a sense of purpose or direction in his or her life, the therapist might help the client to figure out how to find such deeper meaning for him- or herself and to bring it into daily life. The sum of these actions can serve to move the client toward better health and functioning in general, as well as to facilitate improvements in specific medical conditions.

The koshas

There are different ways to organize a holistic client/patient evaluation, but a model commonly employed in yoga therapy involves the concept of the five layers, or "sheaths" (sometimes referred to as *koshas* ; see Table 3.1 , p. 45), a functional model of the human being that was first presented in the *Upanishads* , ancient texts that expanded on and refined concepts from the even more ancient *Vedas* .

The outermost “layer” (metaphorically seen) represents the gross physical structure, or *annamaya* , which comprises all organs and systems, muscles, bones, and so on. This layer is nourished by food (*annam* in Sanskrit). Next comes the *pranamaya kosha* , permeated by the “life-force energy,” or *prana* . In yoga, all activities, movements or operations, assimilation, expulsion, and expression, both at the level of body and mind, are attributed to the function of various aspects of prana (see Table 3.2 , p. 45).

Subtler than the pranamaya kosha is the *manomaya* kosha, the mental level of existence. The mental sheath is the realm of the senses and in addition stores all acquired knowledge, memories, samskaras, and experiences. The manomaya is directly influenced by the prana. If breath is agitated, the mind also gets agitated and vice versa. These layers are seen as interconnected, and so it is possible to use one dimension to influence others. For example, yoga teaches that changing one’s breathing pattern or doing certain movements can influence prana and indirectly influence thought patterns.

Deeper and more subtle than the manomaya is the *vijnanamaya* kosha*,* characterized by discriminative intelligence, that is, the ability to reflect, contemplate, and plan action. To a large extent this is the motivational force that propels us to action. The values and the various intentions and interests that make up a person’s orientation toward life come from this layer. Meditative practices are believed to strengthen this inner core of the person.

The innermost sheath is the *anandamaya* , a layer of bliss or joy. The joy of existence, acquisition, and possession; enjoyment of sense objects; and all forms of happiness come from this source. The concept of being at peace with oneself, contentment, and happiness based on one’s internal state originates here.

The *koshas* are really just a model to try to understand existence. Although yogis speak of five layers, they believe they are all aspects of the same singular consciousness, which is reflected at different layers, and all of these are integrated and interdependent. In addition, yoga proposes a level beyond the *koshas* , a transcendental state of pure conscious awareness: the Self, or spirit. Understanding a person's functional status on each of these levels as well as their core strengths helps in charting therapeutic yoga interventions.

The gunas

Yoga and ayurveda, and the *Sankhya* philosophy from which they both sprang, identify three general states of mind, described by three qualities called *gunas* . The three gunas are *tamas, rajas* , and *sattva* . Tamas is a state of heaviness, lack of movement, of metaphorically being stuck. The kind of depression where a person sleeps excessively would be considered tamasic. Rajas implies movement, and a rajasic mental state is characterized by restlessness, agitation, and even panic. *Sattva* is the state of clarity, peace, and balance.

Sattva is viewed as the natural state of the mind; rajas and tamas are considered factors in disease. In ayurveda it is sometimes said that there are five causes of disease: *vata, pitta, kapha,* tamas, and rajas. Even though two people carry the same diagnosis, say depression, if one is tamasic and the other rajasic, the yoga therapist's approach may need to be different.

In yoga and yoga therapy, the goal is to take people who are tamasic and raise them first to a rajasic state, often through stimulating practices. Once clients are able to move out of their "tamasic slump," the therapist can shift the focus to moving them from rajas toward sattva, often with relaxing practices. If the yoga therapist were to give relaxing practices to someone who was tamasic, that might only serve to deepen the tamas.

Prana and subtle physiology

The flow of energy, or *prana* , is a crucial concept in yoga and yoga therapy. In yoga, prana is considered the animating force of life, absorbed via the air and food. Disturbances in both the amount and directional movement of prana in the body are considered factors in disease. Although sometimes equated with the breath, prana is more correctly viewed as flowing with the breath. Most yoga practices focus on regulating and containing the movement of prana, and the breathing techniques of pranayama are specifically designed to do so.

In yogic and ayurvedic thinking, there are five subdivisions of prana, called the prana *vayus* (see Table 3.2 , p. 45). Each is said to reside in a specific location in the body, to have certain functions, and to move in a particular direction. *Apana* vayu, for example, lives in the pelvis, moves downward, and is linked to eliminative functions such as defecation, urination, and menstruation. From an ayurvedic perspective, a lack of *apana* is linked to a wide variety of conditions, from constipation to migraine headaches to unresolved grief. Certain yoga practices, such as standing poses, are said to be “grounding,” which is another way of saying they can increase apana vayu. Note that one of the prana vayus is also called *prana,* which brings energy from the environment into the body. To avoid confusion, yogis sometimes refer to it as *pran,* or *prana vayu* .

Although the movements of prana in the body may be perceptible to experienced yoga practitioners, there is as yet no accepted scientific explanation of prana or any method to measure it. One possibility is a hypothesized connection between piezoelectric forces transmitted through connective tissue (fascia), known as meridians, that has been proposed as an explanation of the analogous concept of *chi* in traditional Chinese medicine (TCM) (Keown, 2014).

Prana is said to flow in the body via hypothesized pathways, the *nadis,* considered analagous to the meridians in TCM. Junctions of multiple nadis, called *chakras* (wheels), are said to run up and down the spine. Both nadis and chakras are invisible to the naked eye. Although in modern times several attempts have been made to link the various chakras to specific nerve plexuses or endocrine glands (though which ones sometimes differs), yoga philosophy describes chakras as residing in the energetic body (pranamaya) rather than the physical body (annamaya).

According to the yoga tradition, the flow of prana can be impeded when the nadis are blocked. Some yoga practices are performed specifically to purify the nadis in order to restore well-being. The archetypal practice for cleansing the nadis is *nadi shodhana* , alternate-nostril breathing. In this practice, the yoga practitioner exhales then inhales through one nostril, then exhales and inhales through the other, and then repeats this cycle.

Ancient yogic texts speak of tens of thousands or more *nadis* , but in practice three are considered to be of primary importance. The *sushumna* is the so-called central channel, which is said to traverse the body from the base of the spine to the crown of the head. This is the pathway that the hypothesized *kundalini* energy takes as it awakens from its dormant state at the base of the spine, traveling to the crown of the head. A so-called kundalini awakening, sought after by many yoga practitioners, may be accompanied by profound and sometimes disturbing experiences (Krishna, 1971).

The right channel, or *pingala* nadi, starts at the base of the spine and criss-crosses the spine at various chakras before terminating at the right nostril. The left channel, the *ida* nadi, mirrors the right and ends at the left nostril (see Fig. 3.7). Pingala is said to be masculine, stimulating, and hot like *yang* in TCM, whereas ida is feminine, calming, and cool like *yin* . Unilateral nostril breathing has been linked to stimulation of the contralateral cerebral hemisphere (Werntz, Bickford, Bloom, & Shannahoff-Khalsa, 1983) as well as changes in intraocular pressure, heart rate, lung aeration, and so on (Shannahoff-Khalsa, 2007).

There are six or seven (depending on how they are counted) main chakras along the spine (see Fig. 3.7), and the first five, starting at the base of the spine, are each associated with a different one of the five elements enumerated in Sankhya philosophy. The root chakra, known in Sanskrit as *muladhara* , for example, is associated with the earth element. Some yoga therapists use visualizations of the chakras or meditations with a focus on a chakra as part of their approach. Each chakra has a particular sound, a *bija* (seed) mantra associated with it, for example, *yam* at the heart chakra *anahata* . Chanting (or meditating on) that sound is said to increase the energy of the corresponding chakra.

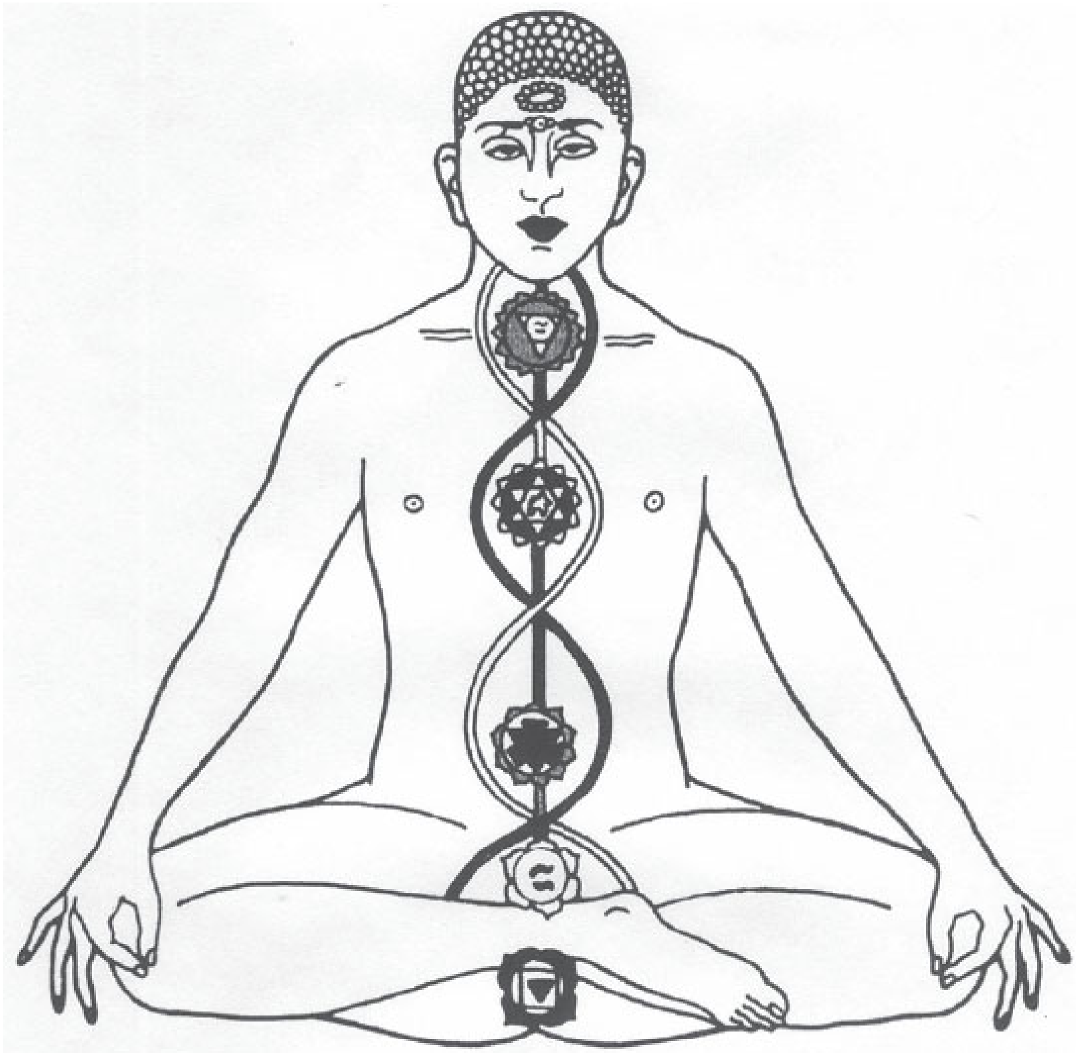

Figure 3.7
Illustration of the *chakras* and three main *nadis* .
Originally published in *The Serpent Power* by Arthur Avalon (Sir John Woodroffe) in 1919.

Ayurveda and yoga therapy

Many yoga therapists consider ayurveda, India's traditional medical system, to be a natural complement to yoga that helps them to better personalize their yoga therapy prescriptions. Ayurveda can be viewed as a system of grouping people based on observable characteristics (i.e., phenotype), such as the size and shape of the hands, color, and texture of the hair, as well as on psychoemotional characteristics such as personality, temperament, and so on.

According to Ayurveda, each one of us has an inborn constitution, or *prakriti* , that shapes our bodies, minds, and predilections. In ayurveda, there are three main constitutional types (*doshas*) of vata, pitta, and kapha. In addition, prakritis like vata–pitta, in which two doshas are balanced fairly evenly, are common; a few people are *tridoshic* , meaning that they have a more or less even balance of all three. People of different prakritis tend to have different body types, personalities, and susceptibility to various diseases. Different ayurvedic phenotypes appear to be associated with different genotype patterns (Bhushan, Kalpana, & Arvind, 2005; Joshi, 2010).

The Sanskrit word *dosha* literally means "that which becomes imbalanced." In general, it is the current imbalance (*vikruti*) more than the constitution (prakriti) that influences the recommended yoga therapy practice. It is important to understand that balance in ayurveda does not mean bringing vata, pitta, and kapha to a state in which they are all equal, but rather to the state in which the current level of each dosha matches the balance found at conception. In other words, the doshas are balanced when the vikruti is the same as the prakriti (see Table 3.3 , p. 46).

These temporary imbalances (vikruti) often reflect the patient's underlying prakriti. While people of predominantly vata nature, for example, are more likely to develop vata imbalances, people of any constitution who undergo the movement, disruption, and stimulation of international travel may find their vata getting increased. Parenthetically, much of what is considered stressful in modern life is, from an ayurvedic standpoint, a manifestation of vata, and vata imbalance is viewed as a major factor in most disease.

The foundation of Ayurveda is in using simple dietary and lifestyle habits to keep in balance. Ayurveda advises living in alignment with nature’s cycles: daily, seasonal, and time of life. Yoga therapy influenced by Ayurveda is in part about adapting clients’ yoga practices to meet their changing needs in different seasons, times of day, and stage of life.

Similar to ancient Greek medicine, Ayurveda speaks about the elements that underlie physical reality. In the case of Ayurveda, there are five: earth, water, fire, air, and space. However, the word “elements” is in this usage a rather unfortunate translation. Better terms might be the five *properties* or *states* of matter. Earth represents solidity, things that have mass and volume. Water is liquid; it flows and takes the shape of the vessel it is contained in. Air is a gas, something that is light and in constant motion. Fire is the power of transformation, of metabolism. Space is a vacuum—the container that holds all the other elements.

In Ayurvedic thinking, *kapha dosha* is associated with the earth and water elements. Think heavy and stable. Those in whom kapha is predominant tend to be strong, with tremendous endurance, but also tend toward laziness. More than people of other constitutions, kaphas tend to be sedentary. Kaphas are prone to depression, overweight, mucus-forming conditions such as bronchitis and sinus infections, and type 2 diabetes. If they take care of themselves, however, from the ayurvedic viewpoint, they are also likely to live longer than people of other constitutions.

The pitta dosha is said to reflect a mixture of fire and water, and those in whom this quality predominates are typically passionate and highly intelligent, but they are also prone to anger, impatience, and aggressiveness. Type A personalities are archetypal pitta types. People of this constitution, according to ayurvedic teaching, are more likely to develop inflammatory conditions such as lupus, skin eruptions, and heart disease.

In the vata dosha, the air and space elements dominate. People in whom vata is predominant tend to be creative and high-energy, in constant motion but easily distracted, and sometimes impulsive. They are said to be more likely to develop conditions such as anxiety, degenerative diseases such as osteoarthritis, and diseases of the nervous system. Constipation and insomnia are common complaints.

Yoga therapy clinical evaluations

In assessing the student, the yoga therapist uses three main tools:

1. Observation (*darsanam*)

2. Palpation (*sparshanam*)

3. Interview (*prashnam*).

Observation includes detailed assessment of structure; alignment of the spine; compensation for any injuries or deformities; weight distribution, muscle tone and strength; balance and gait; function of sense organs; facial expressions; heaviness or lightness in the body; breathing comfort and its characteristic response to movements, exertion, emotional tone, stressors; and more. *Darsanam* may involve watching the student perform asana, breathing techniques, and other tools of yoga. To a large extent, observation gives an index of the physical capacity for practice and also the level of flexibility and breathing capacity, which help determine the appropriate intervention. Observation suggests to the therapist the techniques (and possible modifications) that may be used, as well as the sequencing of practices.

Box 3.1 Various yogic tools used in yoga therapy
Asana (physical postures)
Pranayama (breathing techniques)
Dhyana (meditation)
Guided meditation practices, e.g., yoga nidra
Chanting of mantra
Yogic seals and gestures (*mudra*)
Energetic locks (*bandha*)
Cleansing exercises (*kriya*)
Selfless service (*karma yoga*)
Devotional practices (*bhakti yoga*)
Visualization/imagery
Diet
Ritual
Faith
Yoga philosophy (*jnana yoga*)
Intention (*sankalpa*)

The physical examination may include palpation of the spine, various muscles, the skin, and so on. The yoga therapist may take the pulse at different places in the body as a physician does. Therapists who have been trained to do so may supplement the physical examination with techniques borrowed from Ayurvedic assessment, including pulse (a detailed methodology different from assessing pulse in modern medicine) and tongue diagnosis.

Prashnam , or questioning, is where the yoga therapist obtains information from the client about lifestyle, attitudes, socio-cultural background, and so on and thereby gains insight into the deeper personality and functional styles of the client. It also includes a detailed history of the specific diseases or dysfunctions the client complains of, as well as any medications he or she may be taking. In addition, the yoga therapist may look for potential resources and positive aspects of the client's personal life—which could be a healthy habit, a faith in God, an ability to regulate breath, or even a talent for art or music—with an eye toward potentially incorporating these into the therapeutic strategy.

Because regular—ideally daily—practice is considered crucial to success in yoga therapy, the therapist also ascertains the minimum amount of time that students can devote to their practice. For many people, this will be between 5 and 30 minutes per day. In addition, if props are required for any of the practices the therapist would like to recommend, he or she will determine whether the client has props at home (or substitutes for props the client may have, such as cushions and blankets) or is willing to purchase them. Finally, the yoga therapist needs to ask whether there are any yoga tools (see Box 3.1), for example, chanting, which the student would *not* feel comfortable doing, and these would then not be included in any of the recommended routines.

Table 3.1 Panchamaya kosha (five dimensions of existence)

Kosha (sheath)	**Explanation**
Annamaya	The body, literally the "food" sheath
Pranamaya	The layer of energy (prana)
Manomaya	The lower mind, the senses
Vignanamaya	The higher, discriminative mind
Anandamaya	The sheath of bliss

Table 3.2 Five divisions of prana: the prana vayus			
Name	**Location**	**Description**	**Function**
Prana	Chest, head	Brings energy into the body	Absorption
Samana	Navel region	Brings energy from the periphery to the center	Balancing
Vyana	Throughout the body	Brings energy from the center to the periphery	Circulation
Apana	Pelvic region	Brings energy downward	Elimination
Udana	Throat region	Brings energy up and out of the body	Speech, expression, work

Table 3.3 Ayurvedic doshas and associated properties	
Dosha	**Elements or properties**
Vata	Space (ether) and air (wind)
Pitta	Fire and water
Kapha	Water and earth

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CHAPTER FOUR

RESEARCH ON THE PSYCHOPHYSIOLOGY OF YOGA

L SCHMALZL • CC STREETER • SBS KHALSA

Introduction

Yoga as a multicomponent practice

Yoga-based practices are inherently multifaceted in nature. In modern contexts, they typically involve a combination of specific postures or movement sequences, breath regulation, deep relaxation, and meditative techniques (Gard et al., 2014b). There are numerous “styles” of yoga-based practices representing various schools and lineages of yoga. Most of them differ in terms of the relative emphasis that is put on each of the main components as well as how these components are taught, which in turn impacts their psychophysiological effects. This chapter will outline what is currently known about the psychophysiology of the main components of yoga-based practices, and how they work in concert, primarily based on basic research studies (i.e., psychophysiology research on healthy populations).

History of basic psychophysiological research on yoga

Basic research on yoga-based practices began in the early twentieth century with the work of Swami Kuvalyananda, founder of the Kaivalyadhama Research Institute and the first yoga research journal, *Yoga Mimamsa* , which was launched in 1924. Kuvalyananda and colleagues conducted dozens of studies on individual yoga practices, which were published in their journal over the next four decades. Many of the early studies focused on investigating the effects of individual physical or respiratory practices with the use of X-rays and measures of air pressure, O_2 and CO_2 levels, acid/base balance, and blood pressure. For Western scientists, interest in the psychophysiology of yoga was likely inspired by the reports of remarkable feats of expert yoga practitioners, such as the ability to slow/stop heart rate and to reduce metabolism sufficiently to survive in airtight enclosures. These led to observational studies and subsequently published reports in the 1950s and 1960s, which affirmed the ability of these practitioners to self-regulate internal psychophysiological processes including heart rate, respiration, metabolism, and autonomic nervous system functioning (Wenger & Bagchi, 1961).

Psychophysiology of yoga postures and movement sequences

Characteristics of yoga postures and movement sequences

Modern yoga-based practices typically have a strong emphasis on postures and movement sequences (Singleton, 2010). In fact, particularly in the West, there are yoga practice styles consisting solely of posture or movement sequences that exist alongside more traditional multicomponent contemplative yoga practice styles. Yoga postures and movements can range from large and overt to small and subtle and may even include purely internal or imagined motion (Schmalzl, Crane-Godreau, & Payne, 2014). Some types of practices involve dynamic and continuous physical movement with a focus on creating a “flow” by linking one posture to the next (Jois, 1999), some are more static with individual postures being held for a longer period of time (Iyengar, 1966), and some employ a combination of flowing movement sequences and static postures.

There are innumerable individual yoga postures and variations thereof, which are typically aimed at increasing range of motion, strength, endurance, flexibility, and balance, as well as promoting relaxation and well-being. In broad terms, yoga postures can be divided into categories including standing postures, seated postures, supine postures, forward bends, backbends, lateral bends of the spine, twists, hip-openers, and inversions. Postures are often instructed using precise alignment cues, and depending on the type of practice, they can be held for just a few breaths or as long as a few minutes. When practices involve the dynamic sequencing of individual postures, this is typically performed in a slow, rhythmic, and symmetric manner that is synchronized with the breath.

In practicing yoga postures there is often an emphasis on activating interior muscle groups, which facilitates the maintenance of a strong core musculature and the support of breath regulation while moving through the postures. More generally, there is a focus on obtaining and maintaining a balanced muscle tone that promotes a quality of motion that is stable and well rooted yet light and relatively effortless. Specific individual postures may be characterized by a hypertonic (e.g., arm balances that require a high level of muscle tension) or hypotonic (e.g., a supine relaxation pose) state, but the overall aim is to obtain a state of eutony, or "well-balanced tension" (Alexander, 1985). Lastly, an important characteristic of posture practice is the emphasis on attending to interoceptive, proprioceptive, kinesthetic, and spatial sensations, which are all used to adjust and fine-tune one's movements and positioning.

Brief review of basic research studies on yoga postures and movement sequences

In spite of the emphasis on the physical component in modern yoga-based practices, little is known about the specific effects of the postures and movement sequences per se. One aspect that makes it inherently challenging to isolate the effects of the movement component as such, is that most yoga-based practices are typically instructed in combination with some type of breathing and/or meditation techniques. Postures and movement sequences are typically performed in a slow and controlled manner that requires balance, coordination, and continuous monitoring of the body's position in space. It has been proposed that such coordinated movement of moderate intensity, which is also characteristic of other forms of mindful movement, such as qigong, is more likely to help promote parasympathetic tone compared to more vigorous forms of physical exercise (Payne & Crane-Godreau, 2013). In addition, movement sequences in which joint load is mostly kept at submaximal levels, such as sun salutations, have been suggested to be beneficial for bone remodeling and osteogenesis (Omkar, Mour, & Das, 2011).

Positive effects of movement-based yoga practices have been reported for muscular strength and endurance, flexibility, and cardiorespiratory fitness (Tran, Holly, Lashbrook, & Amsterdam, 2001). In addition, studies comparing yoga-based movement with conventional forms of exercise have often found yoga to be as effective as or better than exercise in a variety of health-related measures, such as improvement of fatigue, self-esteem, and quality of life (Taspinar, Aslan, Agbuga, & Taspinar, 2014). Moreover, when compared to metabolically matched exercise such as walking, yoga has been found to be more effective in improving mood and decreasing anxiety, which corroborates the claim that the benefits of posture practice extend beyond the physical realm (Streeter et al., 2010). In terms of energy expenditure, yoga-based practices are generally considered to be at a lower level compared to other forms of aerobic exercise (Ray, Pathak, & Tomer, 2011). The metabolic costs of yoga may therefore often not meet the criteria recommended for improving or even maintaining cardiovascular fitness in the general population, unless they incorporate a large extent of dynamic movement sequences such as vigorous or rapid sun salutations (Hagins, Moore, & Rundle, 2007). Similar arguments have been put forward for some pulmonary functions, for which yoga seems to be less effective than other forms of physical activity such as swimming (Gupta & Sawane, 2012).

There are a number of hypothesized neurophysiological and neurocognitive mechanisms that are likely to be affected by, and mediate the effects of, yoga-based movement. One of these relates to the specific effects of stretching, and in particular to the biomechanical behavior of part of the connective tissue known as fascia. When connective tissue is stretched, fibroblasts expand by actively remodeling their cytoskeleton, which contributes to a change in extracellular-fluid dynamics and prevents tissue tension and swelling. If the stretching action is performed for several minutes, the overall compactness of the connective tissue in a specific area can decrease, which in turn promotes the flow of fluid from the capillary bed into the extracellular space. These mechanisms, supported by many yoga poses that involve prolonged stretching, are proposed to play an important role in regulating tissue fluid, metabolic homeostasis, and even immune surveillance (Langevin, Nedergaard, & Howe, 2013).

A second proposed mechanism is the activation of vagal afferent activity (Porges, 2001). The vagus nerve, which regulates several visceral organs as well as striated muscles of the face, head, and neck, is one of the key components of autonomic regulation (Porges, 1995). The majority of vagal nerve fibers are afferent, communicating peripheral information about bodily states to the brain (Berthoud & Neuhuber, 2000). Vagal tone is strongly impacted by the slow and rhythmic breathing employed in yoga-based practices (Brown & Gerbarg, 2005). However, the movement component plays an important role in promoting vagal afference as well. For example, yoga postures often enhance the depth of the breath (e.g., active expansions/contractions of the rib cage during backbends and forward bends), further strengthening core diaphragmatic muscles and enhancing baroreceptor sensitivity (Strongoli, Gomez, & Coast, 2010). In addition, many postures emphasize abdominal tone through interior muscle activation, which additionally promotes peripheral vagal stimulation and afference (Ritter, Ritter, & Barnes, 1992).

A third group of mechanisms relates to the functional characteristics of the basal ganglia (BG). Many of the movement-related aspects of yoga-based practices engage BG circuits (McHaffie, Stanford, Stein, Coizet, & Redgrave, 2005), which consist of semi-independent loops that originate from specific cortical regions, pass through functionally corresponding portions of the BG, and return to the same cortical areas via the thalamus (Alexander, 1994). These cortico-BG-thalamic loops support body awareness, motor coordination, and procedural learning, all of which are implicated in the movement aspect of yoga-based practices. In addition, these loops are also involved in a series of more complex higher order cognitive functions, and even in social behavior (Arsalidou, Duerden, & Taylor, 2013). It can be hypothesized that yoga-based practices may promote increased connectivity within, and dynamic shifting between, motor, cognitive, and emotional circuits, with potential beneficial effects for mind-body integration and self-regulation. Supporting evidence for this hypothesis comes from recent neuroimaging work documenting more widespread functional connectivity within these loops in expert yoga practitioners compared to controls (Gard et al., 2015).

Lastly, there is the common belief and claim in yoga that selective physical postures and movements can be used to target very specific psychophysiological effects. This is proposed to apply not only to physical functioning, such as the effect of stretching on flexibility and range of motion, but also to psychological states. Supporting this claim, it has been shown that posture can affect neuroendocrine levels, risk propensity, and pain tolerance. For instance, so-called "high-power" postures that are characterized by, and suggestive of, high degrees of expansiveness, openness, assertiveness, and confidence have been reported to lead to decreased levels of cortisol and increased levels of testosterone, as well as self-perceived feelings of psychological power (Carney, Cuddy, & Yap, 2010). Similarly, adopting a dominant, as opposed to submissive or neutral physical posture, has been shown to affect pain tolerance (Bohns & Wiltermuth, 2012). It has also been suggested that posture affects our recall of positive and negative thoughts, with positive thoughts being more easily generated in upright compared to slumped postures (Wilson & Peper, 2004). Similarly, assuming a slumped compared to an upright posture has been shown to be associated with higher degrees of perceived helplessness (Riskind & Gotay, 1982). Hence, it is hypothesized that by changing physical posture, individuals can enhance their physiological and mental resistance to external and internal stressors, and impact their perceived self-efficacy and mood state. Preliminary evidence for how yoga postures can affect mood state was published in a study reporting that compared to forward bends or standing poses, backbends seem to be associated with greater increases in positive mood (Shapiro & Cline, 2004). This finding has potential implications for clinical applications in mood disorders, and it calls for more studies comparing the efficacy of different types of yoga-based postures and movement for various clinical populations. Finally, a common belief in yoga is that specific limb positions or angles, as well as specific positions of the hands and fingers (mudras) also have specific psychophysiological effects. There is, however, currently no biomedical research supporting this claim.

Psychophysiology of yogic breathing techniques

Characteristics of yogic breathing techniques

The various yoga traditions employ a multitude of breathing practices, which can be practiced alone or in the context of postures and movement sequences. In some types of practices, postures and movement sequences are instructed in conjunction with a very specific breathing pattern, whereas in others there is simply a focus on maintaining an even rhythm of inhalations and exhalations with no direct emphasis on linking the movements with the breath. The breath can also merely serve as an object of attention, as in many meditation practices. Breath regulation can have a number of different physiological effects depending on what type of breathing is emphasized (Brown & Gerbarg, 2005). Slow and rhythmic breathing is proposed to promote parasympathetic dominance (Sovik, 2000), whereas more forceful breathing practices may actually promote sympathetic activation (Beauchaine, 2001). A slow and rhythmic breathing pattern, with a frequency of about six breaths per minute or slower, is the most common yogic breathing practice. A practice known variously as diaphragmatic, abdominal, or belly breathing, in which there is an emphasis on the involvement of abdominal movement, has long been adopted by many Western yoga therapists. Compared to a more superficial breath that involves predominantly chest movement, this breathing pattern ensures a deeper and slower breath with a larger tidal volume. A slow-breathing technique that is often used in modern yoga-based practices is the so-called *ujjayi* breath (Brown & Gerbarg, 2005). It is a deep, slow, and rhythmic abdominal breath that is performed through the nostrils with concurrent narrowing of the glottis, which creates a soft and soothing sound. During inhalations the breath is visualized as rising from the lower belly, through the ribcage, to upper chest and throat, and exhalations follow the opposite order. Inhalations and exhalations are usually recommended to be of equal length, and their duration can gradually extend with practice. Other well-known breathing techniques include *kapalabhati* (rapid abdominal breathing involving short and forceful contraction of the anterior abdominal wall), *bhastrika* (rapid thoracic breathing using intercostal and accessory muscles), *sitali pranayama* (slow breathing through puckered lips with a curled tongue), *nadi shodhana* (alternate nostril breathing), and *kumbhaka* (retention of the breath for various durations either after inhalations, exhalations or both). Although there is strong evidence for psychophysiological benefits of yogic breathing techniques, a common misconception among yoga practitioners is the belief that these techniques increase blood oxygenation. In fact, although they impact respiratory rate and minute ventilation, they do not significantly change oxygen or carbon dioxide levels (Frostell, Pande, & Hedenstierna, 1983).

Brief review of basic research studies on yogic breathing techniques

As with postures and movement sequences, specific psychophysiological changes have been associated with different breathing practices. Both Eastern yoga traditions and Western science on respiratory physiology support the view that emotional states can be expressed in breathing patterns, and consequently that breath regulation can influence emotional states (Boiten, Frijda, & Wientjes, 1994; Brown & Gerbarg, 2005; Henje Blom, Serlachius, Chesney, & Olsson, 2014). For example, a common autonomic stress response is rapid thoracic breathing, which can possibly lead to hyperventilation and a change in tidal volume (Laffey & Kavanagh, 2002).

Slow and rhythmic breathing has been shown to have marked effects on psychophysiology and respiratory function. In fact, it has been shown that slowing down of the breathing rate to about six breaths per minute decreases chemoreflex sensitivity (Spicuzza, Gabutti, Porta, Montano, & Bernardi, 2000) and oxidative stress (H. Sharma et al., 2003). Conversely, it increases cardial-vagal baroreflex sensitivity (Esposito et al., 2015) and promotes the release of prolactin and oxytocin, which can foster feelings of calmness and social bonding (Torner, Toschi, Clapp, & Neumann, 2002). The positive effects of slow abdominal breathing, and its efficiency due to the deeper expansion of the lungs with each breath, have also been documented in other arenas. A notable example is a study showing that extreme altitude climbers who were able to reach the highest summits without supplemental oxygen at peak altitude were found have a slower endogenous breathing rate, lower minute ventilation, more efficient respiration, and a higher ventilator reserve. The slower breathing rate was also correlated with a lower increase in heart rate and blood pressure from sea level to altitude (Bernardi, Schneider, Pomidori, Paolucci, & Cogo, 2006).

As mentioned earlier, one of the main ways through which slow breathing is proposed to impact autonomic regulation is by promoting vagal afference (Porges, 2001). It is proposed that vagal tone is reflected by the variability of the inter-beat intervals of the heart, that is, heart rate variability (HRV) (Porges, 2001), and that it is especially mirrored by the HRV within the frequency of respiration, that is, respiratory sinus arrhythmia (RSA) (Calabrese, Perrault, Dinh, Eberhard, & Benchetrit, 2000). There is also an interaction between breathing frequency and HRV as well as arterial baroreflex sensitivity, with slower breathing rates promoting an increase of both these indices (Bernardi, Gabutti, Porta, & Spicuzza, 2001). Moreover, the type of breath employed in yoga-based practices has been suggested to promote synchronization of cortical areas via stimulation of thalamic nuclei, and consequently impact alertness and executive functioning (Calabrese et al., 2000; Tsigos & Chrousos, 2002). In terms of yogic breathing techniques, the *ujjayi* breath described above induces an increase of airway resistance via contraction of laryngeal muscles, which has been proposed to be particularly effective in stimulating somatosensory vagal afferents to the brain (Brown & Gerbarg, 2005) and in turn promoting autonomic regulation (Calabrese et al., 2000). Alternate nostril breathing, which involves breathing though the left and right nostril alternately, with or without breath retention, has also been associated with measurable psychophysiological effects. The reported effects include increased parasympathetic nervous system activity as measured my heart rate parameters and orthostatic tolerance (Sinha, Deepak, & Gusain, 2013), increased HRV and decreased systolic blood pressure (Telles, Sharma, & Balkrishna, 2014), and changes in the P300 auditory evoked potential, which is reflective of cognitive processes required for sustained attention (Telles, Singh, & Puthige, 2013). In addition, there is evidence for laterality effects, with breathing through individual nostrils affecting autonomic regulation and brain responses in specific ways. For example, left- and right-nostril breathing respectively have been shown to differentially affect oxygen consumption (Telles, Nagarathna, & Nagendra, 1994), blood pressure parameters (Raghuraj & Telles, 2008), as well as the P300 auditory evoked potential, which seems to be more affected in the brain hemisphere contralateral to the nostril (Telles, Joshi, & Somvanshi, 2012).

Complementary to the positive effects of slow breathing, there are specific benefits related to more rapidly paced breathing. For example, some pulmonary functions may improve more with faster breathing techniques, possibly because they require a higher rate of breath coordination and respiratory muscle activity, which in turn might facilitate strengthening of the respiratory system (Dinesh et al., 2015).

In addition, it has been suggested that compared to slow breathing, fast breathing may have additional beneficial effects for working memory and sensorimotor performance (V. K. Sharma et al., 2014).

Psychophysiology of relaxation practices

Characteristics of yoga relaxation/yoga nidra

Deep relaxation is a fundamental aspect of yoga, and each practice session typically ends with a supine relaxation pose (corpse pose) often involving a systematic progressive relaxation throughout the body's musculature. However, relaxation techniques can also be taught throughout a practice session or even constitute a practice in their own right. A well-known relaxation technique is yoga nidra, which typically includes relaxation, in combination with meditation, breath awareness, and/or guided imagery (Parker, Bharati, & Fernandez, 2013), with a gradual progression from deep relaxation to a near sleep-like state in which individuals remain aware of their surroundings (Miller, 2005). The transitioning through these states is also accompanied by a change in brain waves (Lou et al., 1990).

Brief review of basic research studies on yoga relaxation/yoga nidra

Relaxation techniques, especially progressive muscle relaxation, have been used in modern behavioral medicine and clinical psychology for decades (McGuigan & Lehrer, 2007). They have mostly been studied in the context of treatment for anxiety-related disorders but also for some psychosomatic conditions, including insomnia and chronic pain. According to a systematic review of relaxation training for anxiety-related disorders (Manzoni, Pagnini, Castelnuovo, & Molinari, 2008), progressive relaxation seems to be particularly effective whereas multimodality practices tend to show lower effect sizes. More generally, it has been shown that relaxation interventions lend themselves very well to being integrated into various community, educational, and hospital settings, making them an easily accessible nonpharmacological approach for a variety of populations and clinical conditions (Klainin-Yobas, Oo, Suzanne Yew, & Lau, 2015). Specific application of corpse pose has been shown to induce similar effects to muscle-relaxation techniques, including various autonomic arousal measures. These include increased HRV, as well as reduced levels of blood pressure (Pal, Ganesh, Karthik, Nanda, & Pal, 2014), respiration and oxygen consumption (Sarang & Telles, 2006), energy expenditure (Ray et al., 2011), and symptoms of anxiety (Subramanya & Telles, 2009). For yoga nidra, there is only a limited amount of research, and many of the studies are confounded by a lack of empirical consistency (Parker et al., 2013). Yoga nidra has been found to be effective at reducing stress, depression, and worry, as well as increasing mindfulness (Eastman-Mueller, Wilson, Jung, Kimura, & Tarrant, 2013). In addition, studies using electroencephalography (EEG) have documented increases in both alpha and theta waves associated with this type of practice (Kjaer et al., 2002; Kumar & Joshi, 2009; Lou et al., 1990).

Psychophysiology of meditation

Characteristics of meditation in yoga

Meditative techniques involve various forms of attention regulation. Meditation and the notion of contemplative practice broadly refer to practices involving sustained and non-analytic attention and/or deep consideration of an object of interest. Although the individual practices differ in terms of specifically adopted techniques, they typically involve a disciplined process of becoming reflectively attentive to experience (Schmalzl et al., 2014). Recent theoretical accounts operationalizing the construct of meditative practices refer to them as mental training that develops meta-awareness (self-awareness), increases the ability to effectively modulate one's behavior (self-regulation), and promotes a progressive and positive shift from predominantly self-focused to increasingly decentered and prosocial views of the world (self-transcendence) (Vago & Silbersweig, 2012). For many practitioners, meditation represents a means for cultivating a state of equanimity (Desbordes et al., 2015) that for some has the ultimate aim of transforming habitual self-identity.

A fundamental aspect emphasized in meditative practices is the cultivation of metacognitive awareness, which broadly refers to the conscious monitoring of our own mental processes (Teasdale, 1999). The role of metacognitive awareness can be twofold (Fox & Christoff, 2014). On the one hand, it can have the role of noticing drifts from a selected single object of attention and subsequently redirecting attention back toward it. This meditation form is often characterized as *focused attention* (FA); it is also referred to as *concentrative, closed-focus* , or *single-point-focus* meditation. On the other hand, metacognitive awareness can have the role of monitoring our stream of thought while attempting to maintain detachment and refrain from any cognitive elaboration, analysis, or judgment. This meditation form is often characterized as *open-monitoring attention* (OM), and is also referred to as *open-focus* or *mindfulness* meditation (Lutz, Slagter, Dunne, & Davidson, 2008). For mindfulness-based practices it has been proposed that while beginning practitioners tend to engage predominantly in FA, advanced practitioners tend to engage predominantly in OM. The same may be hypothesized to be true for meditation applied in the context of yoga-based practices. Initially, practitioners may only be able to allocate their attention to one single element of the practice at a time, but with continued practice they may become increasingly skilled at simultaneously monitoring movement, breath, and any concomitant interoceptive and exteroceptive sensations that may arise. However, some of the meditative techniques employed in yoga-based practices are of a strictly FA nature and are performed as such by practitioners of various degrees of expertise. Examples include body-scan meditation (Mirams, Poliakoff, Brown, & Lloyd, 2013), guided imagery meditation (Balaji, Varne, & Ali, 2012), and Transcendental Meditation (TM), which involves repetition of and attention to a specific sound or mantra (Balaji et al., 2012).

Another important characteristic of many meditative techniques in the context of yoga-based practices is a strong emphasis on cultivating attention to bodily sensations and sensory experiences, including interoceptive, proprioceptive, kinesthetic, and spatial awareness (Farb et al., 2015). This is primarily achieved by paying attention to sensations arising from the movement and breath components of the practice. There is increasing consensus that body awareness is of substantial significance for health and self-regulation. For example, enhanced body awareness can reflect an increased ability to observe bodily signals of emotional states without getting caught up in them (Baas, Beery, Allen, Wizer, & Wagoner, 2004). In therapeutic contexts, one of the aims of training body awareness is in fact to increase proprioceptive and interoceptive awareness while reducing self-evaluative processes (Watkins & Teasdale, 2004).

Independent of the specific meditation techniques used, a putative general mechanism through which cultivating attention accounts for psychological well-being is by decreasing mind-wandering (Hasenkamp, Wilson-Mendenhall, Duncan, & Barsalou, 2012) and rumination (Wolkin, 2015). *Mind-wandering* refers to spontaneous and undirected thought processes that mostly occur without our volition, and *rumination* can be defined as the process of dwelling upon predominantly negative thoughts and emotions that are frequently self-focused, which often leads to a vicious cycle of unintentionally directed attention towards them. Increased mind-wandering has been associated with more negative mood states (Killingsworth & Gilbert, 2010), and increased rumination has been found to negatively correlate with various aspects of psychological health and has been described as a risk factor for the development of depression and depressive relapse (Smith & Alloy, 2009). Mind-wandering and ruminative processes can be decreased by engaging in both focused and receptive attention, which foster the ability to decenter and disentangle one’s self-identification with negative thoughts (Segal, William, & Teasdale, 2002).

Brief review of basic studies on meditation in yoga

Meditation practices have been shown to beneficially impact a wide variety of cognitive and health-related functions, including attention (Jha, Krompinger, & Baime, 2007), interoceptive awareness (Farb, Segal, & Anderson, 2013), somatosensory processing (Kerr, Sacchet, Lazar, Moore, & Jones, 2013), self-regulation (Tang, Posner, & Rothbart, 2014), stress (Jain et al., 2007), immune function (Infante et al., 2014), blood pressure (Bai et al., 2015), chronic pain (La Cour & Petersen, 2015), and sleep (Nagendra, Maruthai, & Kutty, 2012).

Much recent research has focused on investigating the neural mechanisms underlying meditative practices. As mentioned above, meditation in the context of yoga-based practices may employ both FA and OM types of attention, depending on the expertise of the practitioner and also on the specific types of meditative techniques that are used. Results from neuroimaging investigations using functional magnetic resonance imaging (fMRI) (Manna et al., 2010) seem to suggest that in general terms, FA predominantly engages right frontal brain areas, whereas OM predominantly engages left frontal brain areas. In regard to FA, recent neuroimaging work has proposed the existence of four distinguishable phases supported by partly independent neurocircuitry (Hasenkamp et al., 2012). These phases occur naturally during formal meditation practice and include mind-wandering, the awareness of the fact that one’s mind has wandered, the redirecting of attention back to the chosen object of meditation, and the active maintenance of sustaining of attention on the object of meditation. Mind-wandering engages brain areas that have been associated with the so-called default mode network (DMN) (Raichle et al., 2001), which refers to regions in which activation is increased during wakeful rest and attenuated during goal-directed behavior. These include the posterior cingulate cortex, the medial prefrontal cortex, the posterior parietal/temporal cortex, and the parahippocampal gyrus. Awareness of mind-wandering engages a subdivision of the attentional network known as the salience network, which is generally associated with supporting conflict monitoring and error detection. It includes the anterior insular cortex and anterior cingulate cortex. Redirecting of attention toward the object of meditation engages the so-called executive network, which includes the lateral prefrontal cortex and the lateral inferior parietal cortex. Lastly, sustaining attention on the object of meditation continues to engage a portion of the executive network, with selective clusters in the dorsolateral prefrontal cortex. For practices that predominantly employ an OM type of attention, neuroimaging studies have also shown alterations in both DMN and metacognitive regions, reflecting again the presence of both mind-wandering and attentional processes (Fox & Christoff, 2014). Because OM meditation involves no selected focus, the attentional component relies less on brain regions involved in engaging or sustaining attention onto a specific object. Instead, it primarily relies on brain regions implicated in monitoring, vigilance, and processing of sensations related to present-moment experience (Lutz et al., 2008). These include order prefrontal regions (Fleming & Dolan, 2012), as well as the anterior cingulate cortex and insular cortex (Critchley, 2005).

The centrality of cultivating attention to bodily sensations and sensory experiences is reflected by numerous neuroimaging studies of meditation practices that have reported both structural and functional changes in brain areas specifically involved in body-focused attention. A recent meta-analysis of structural brain changes associated with meditation practices (Fox et al., 2014) has documented changes in the insular cortex, the primary and secondary sensorimotor cortices, and the anterior precuneus, which are involved in interoceptive awareness, the processing of tactile and proprioceptive sensations, and higher-order body awareness respectively. A separate meta-analysis of functional brain changes associated with meditation practices (Tomasino, Fregona, Skrap, & Fabbro, 2013) also revealed changes in a number of areas involved in the processing of bodily signals, including parietal areas involved in spatial and somatosensory processing, the right supramarginal gyrus, and again the insular cortex. It can be hypothesized that compared to seated meditation practiced in isolation, the context of yoga-based practices, with its added movement component, may provide a larger array and intensity of interoceptive and proprioceptive signals to attend to, potentially facilitating their processing and integration as well as promoting the associated structural and functional brain changes.

As mentioned earlier, one of the principal common mechanisms through which various types of meditative practices are said to enhance psychological well-being is by reducing rumination (Wolkin, 2015). On a neural level, this has been hypothesized to be supported by a shift away and repeated disengagement from DMN activity (Hasenkamp et al., 2012). In addition to mind-wandering, the DMN is said to be involved in the construction of the autobiographical self, which involves the assessment of stimuli for their relevance to the mentally sustained image of oneself. Altered DMN activity during meditative states has therefore been proposed to underlie a shift to less self-centered and more objective awareness of interoceptive as well as exteroceptive present-moment sensory events (Brewer et al., 2011). This theory is corroborated by evidence that increased DMN activity is associated with negative mental health outcomes (Sheline et al., 2009), and that meditation reduces depression vulnerability by buffering against trait rumination and negative bias (Paul, Stanton, Greeson, Smoski, & Wang, 2013).

Psychophysiology of yoga practice as a whole

A logic model showing the main skills acquired through yoga-based practices and their interactions

The logic model depicted in Figure 4.1 attempts to describe the major areas by which yoga practices develop behavioral skills, change psychophysiological state, and ultimate modify behavior and experience. It defines yoga as the multicomponent practice, including postures/movement sequences, breathing techniques, deep-relaxation practices, and meditation represented in the top box, which lead to skills and attributes in the three boxes below. Primarily through the cognitive meditative component, practitioners engage attention networks and through practice over time enhance their ability to hold and regulate attention, including their awareness of both mental (thoughts and emotions) and physical (sensations) states and events. This leads to enhanced mind–body awareness with improved and heightened mindfulness, concentration, and cognitive functioning, as well as self- and social awareness depicted in the left-hand box (see Fig. 4.1). Virtually all of the practices within yoga likely contribute to improved self-regulation skills, particularly regulation of the stress response and emotion regulation. Over time, this leads to improved resilience and stress tolerance, emotional equanimity, and ultimately psychological self-efficacy as depicted in the middle box. The physical and respiratory practices are well-known to improve physical functioning, including flexibility, strength, endurance, balance, and respiratory function, leading to an improved physical self-efficacy depicted in the right-hand box. Although it is useful to describe the content of the three boxes in the middle level separately, they are likely all intimately and mechanistically linked to each other, as suggested by the arrows between these boxes. All of these skills and attributes work to improve multiple behaviors, mental state, health, and performance in the box at the bottom, suggesting that yoga ultimately works in a global and holistic manner to improve human functioning on multiple levels and in multiple domains.

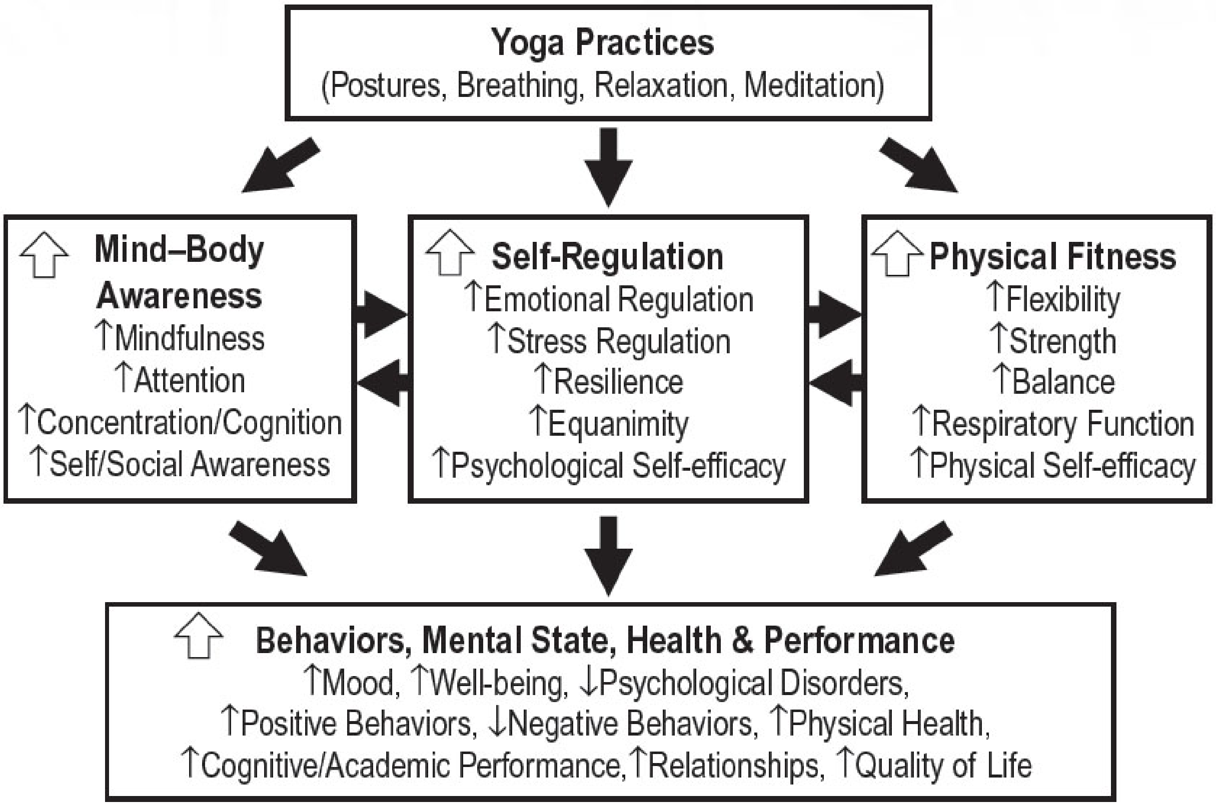

Figure 4.1
A logic model describing the main aspects by which yoga practices develop behavioral skills, change psychophysiological state, and modify behavior and experience.

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Review of the research on physical health

Yoga-based practices have been shown to have an effect on physiological parameters such as stress hormones, inflammatory markers, and cardiovascular indices, all of which impact physical health. For example, it has been reported that yoga reduces cortisol levels more than common exercise (Rocha et al., 2012), and that reductions in cortisol can occur even after a single yoga session (Kamei et al., 2000). Yoga practice has also been associated with increased levels of gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter known to be reduced in various clinical conditions, including epilepsy (Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). Lastly, it has been documented that 6 weeks of yoga can elicit measurable changes in cardiovascular indices, including reduced total peripheral resistance (TPR), as well as increased arterial compliance (CWK), stroke volume (SV), and cardiac output (CO) (Parshad, Richards, & Asnani, 2011), and there is preliminary evidence that 8 weeks of yoga can significantly increase heart rate variability (HRV), which is one of the primary indicators of balanced nervous system activity (Papp, Lindfors, Storck, & Wandell, 2013).

Review of the state of research on body awareness and mindfulness

A few basic research studies have investigated the effect of yoga-based practices on body awareness, a multidimensional construct that entails a combination of proprioceptive and interoceptive awareness (Mehling et al., 2012). Early studies documented increased self-reported body awareness following a 3-month-long yoga program (Rani & Rao, 1994), and more recently it has been suggested that self-reported levels of body awareness in advanced yoga practitioners are related to the character trait of self-transcendence (a trait reflecting an individual's inclination to perceive a strong connection between oneself and all other forms of life) (David, Fiori, & Aglioti, 2014). An elegant recent study using both sensory testing and neuroimaging techniques showed that, compared to participants with no yoga experience, advanced yoga practitioners exhibited increased pain tolerance and that this was correlated with structural brain differences in a number of brain regions that are crucial for body awareness, including the insular cortex, the cingulate cortex, and parietal areas (Villemure, Ceko, Cotton, & Bushnell, 2014). Yoga-based practices have also been shown to increase mindfulness. A study investigating the effects of a residential yoga program on quality of life found that attendees exhibited a reduction in levels of perceived stress, which was statistically demonstrated to be mediated by increased levels of mindfulness and self-compassion (Gard et al., 2012). The authors interpreted these results to suggest that yoga and mindfulness-based interventions share underlying mechanisms. Another study on a Mindfulness-Based Stress Reduction (MBSR) program, which included home practice of sitting meditation, body scan, and hatha yoga, found that the amount of yoga practice time was significantly correlated with increases in mindfulness (Carmody & Baer, 2008). These findings suggest that the hatha yoga component of the home practice played an important role in driving the overall effect of the intervention. Further studies corroborating the view that yoga increases mindfulness include investigations with novices (Bowden, Gaudry, An, & Gruzelier, 2012), advanced yoga practitioners (Brisbon & Lowery, 2011), and yoga teacher trainees (Büssing, Hedtstuck, Khalsa, Ostermann, & Heusser, 2012).

Review of the state of research on self-regulation

The ability to self-regulate stress response and emotional states is essential for an individual's overall well-being. Given existing evidence that meditation alone can improve self-regulation, including both stress and emotion regulation, and that breathing practices can impact autonomic functioning, it is not surprising that yoga as a multicomponent practice can have similar effects. In fact, improvements in stress and emotion regulation are hallmarks of the effects of yoga-based practices (Li & Goldsmith, 2012; Riley & Park, 2015; Sharma, 2014). Early studies documented self-reported increased levels of subjective well-being (Sell & Nagpal, 1992) and vitality (e.g., perceived levels of alertness, sleepiness, enthusiasm, sluggishness, calmness, nervousness, etc.) (Wood, 1993) following programs involving yoga-based practices. More recently, self-reported stress levels have been found to decrease in individuals participating in residential yoga programs involving daily led classes as well as didactic course work focusing on the integration of yoga practices into daily life activities (Gard et al., 2012). Lastly, reduced levels of self-reported stress have been documented in military populations participating in yoga programs, which is particularly meaningful given the inherently stressful environment these individuals are immersed in on a daily basis (Rocha et al., 2012).

Review of the state of research on cognitive functioning

There is growing research on the effect of yoga-based practices on cognition, including attention, memory, and executive functioning. Some studies have reported that yoga-based practices can affect visual attention, with measurable improvements in the ability to detect subtle changes in visual stimuli (Telles, Nagarathna, & Nagendra, 1995) as well as color discrimination (Narayana, 2009). In regard to memory, improvements have been documented in working memory (Gothe, Pontifex, Hillman, & McAuley, 2013) as well as short-term and long-term memory (Rocha et al., 2012). As for executive functioning, positive effects have been reported for problem-solving ability (Manjunath & Telles, 2001), and it has been proposed that yoga may in fact promote neuroplastic changes in systems that support executive functioning (Froeliger, Garland, & McClernon, 2012). Yoga practitioners have also been found to more efficiently activate cognitive control brain networks in the presence of emotionally salient stimuli (Froeliger, Garland, Modlin, & McClernon, 2012). Lastly, it has been documented that experienced yoga and meditation practitioners show less age-related decline in fluid intelligence (i.e., a set of abilities involved in coping with novel environments and abstract reasoning) compared to controls (Gard et al., 2014b).

Hypothesized effects of yoga-based practices on allostatic and autonomic regulation

Allostasis refers to the ability of an organism to maintain homeostasis and stability through change by actively adjusting to both predictable and unpredictable events (McEwen & Wingfield, 2003). Some of the primary mediators of allostasis in humans are hormones of the hypothalamo–pituitary–adrenal (HPA) axis (e.g., cortisol), excitatory catecholamines (e.g., adrenaline), and immunomodulatory cytokines (e.g., interleukins). An imbalance of these primary mediators is referred to as *allostatic state* , and the cumulative effects of allostatic state over time are referred to as *allostatic load* (Juster, McEwen, & Lupien, 2010). By impacting the autonomic nervous system (ANS), yoga-based practices can be an effective tool for the downregulation of allostatic load and consequently facilitate adaptive stress responses.

One of the key components for the regulation of allostatic load in humans is the vagus nerve, the tenth of the cranial nerves, which has axons that emerge from and converge onto four different brainstem nuclei. The function of the vagus nerve has phylogenetically evolved to mediate stress responses by regulating cardiac output and influencing engagement/disengagement with the environment (Porges, 2001), and in fact physical, affective, cognitive, and social processes have all been shown to be associated with vagally mediated cardiac function (Porges, 2007). As mentioned in some of the previous sections of this chapter, yoga-based practices are intrinsically tailored to promote vagal tone and consequently decrease allostatic load in a number of ways. On a direct level, there are the parasympathetic effects of slow and rhythmic breathing (Brown & Gerbarg, 2005), the enhancement of the depth of the breath and hence its physiological effects via physical postures (Strongoli et al., 2010), and the promotion of peripheral vagal stimulation and afference via interior muscle activations (Ritter et al., 1992). On a more indirect level, maintaining a steady breath during the physical, mental, and emotional challenges of the practice represents an opportunity to apply nonreactive awareness in the face of stress. In that sense, yoga-based practices represent an effective way of developing strategies for dealing with challenging experiences while cultivating an internal sense of calmness, with the further potential and ultimate aim of generalizing these skills from the practice on the yoga mat and meditation cushion to everyday life situations.

Yoga-based practices have also been associated with changes in GABA levels (Streeter et al., 2007). GABA is the primary inhibitory neurotransmitter in humans, and its clinical relevance is supported by evidence of significantly reduced GABA levels in various conditions including depression, anxiety, and epilepsy (Brambilla, Perez, F., Schettini, & Soares, 2003; Breier & Paul, 1990; Houser, 1991). Interestingly, it has been documented that in addition to being responsive to vagal nerve stimulation (VNS) (Henry, 2002; Nemeroff et al., 2006) and pharmacotherapies that increase brain GABA levels (Fischell, Van Dyke, Kvarta, LeGates, & Thompson, 2015), the symptoms of mood disorders as well epilepsy can also be alleviated with yoga-based therapies (Streeter et al., 2012). This supports the hypothesis that one of the mechanisms through which yoga-based practices effect positive changes in mood and brain function is through stimulation of vagal afferents and its consequent impact on the GABA system.

The concept of *neuroception* (Porges, 2003) refers to the contribution of bottom-up processes such as vagal afference, sensory input, and endocrine mechanisms to the detection and evaluation of risk prior to its conscious elaboration by higher brain centers. Vagal afference is mediated via the thalamus to the insula, anterior cingulate, and prefrontal cortex, which are all involved in emotion regulation (Thayer & Sternberg, 2006). In fact, neuroimaging studies have shown that VNS is associated with functional changes in these brain regions (Barnes et al., 2003; Henry, Bakay, Pennell, Epstein, & Votaw, 2004; Kraus et al., 2007). Conversely, by detecting and evaluating risk, higher brain centers can affect autonomic regulation and the expression of adaptive defensive behaviors. For example, brain structures such as the amygdala and prefrontal cortex, which are involved in fear-detection, attentional mechanisms, and self-regulatory behaviors (McEwen & Gianaros, 2011), are linked via the vagus nerve to the regulation of autonomic functions and metabolic systems (Thayer & Sternberg, 2006). Similarly, temporal brain areas involved in the perception of biological motion, faces, and vocalizations (Adolphs, 2002) can impact physiological responses and allostatic load (Porges, 2007). Given that yoga-based practices affect both bottom-up physiological and top-down cognitive processes, they are an ideal method for exploring and impacting the interplay between the body's stress responses and regulatory systems (Streeter et al., 2012) (see Fig. 4.2).

Limitations of research on yoga-based practices

It is clear that the past few decades have witnessed a strong and increasing interest in yoga research. While this is supportive for the field of yoga and yoga therapy practice, it is important to be aware that many published studies on yoga-based practices have methodological limitations that prevent us from being able to make conclusive claims about their findings.

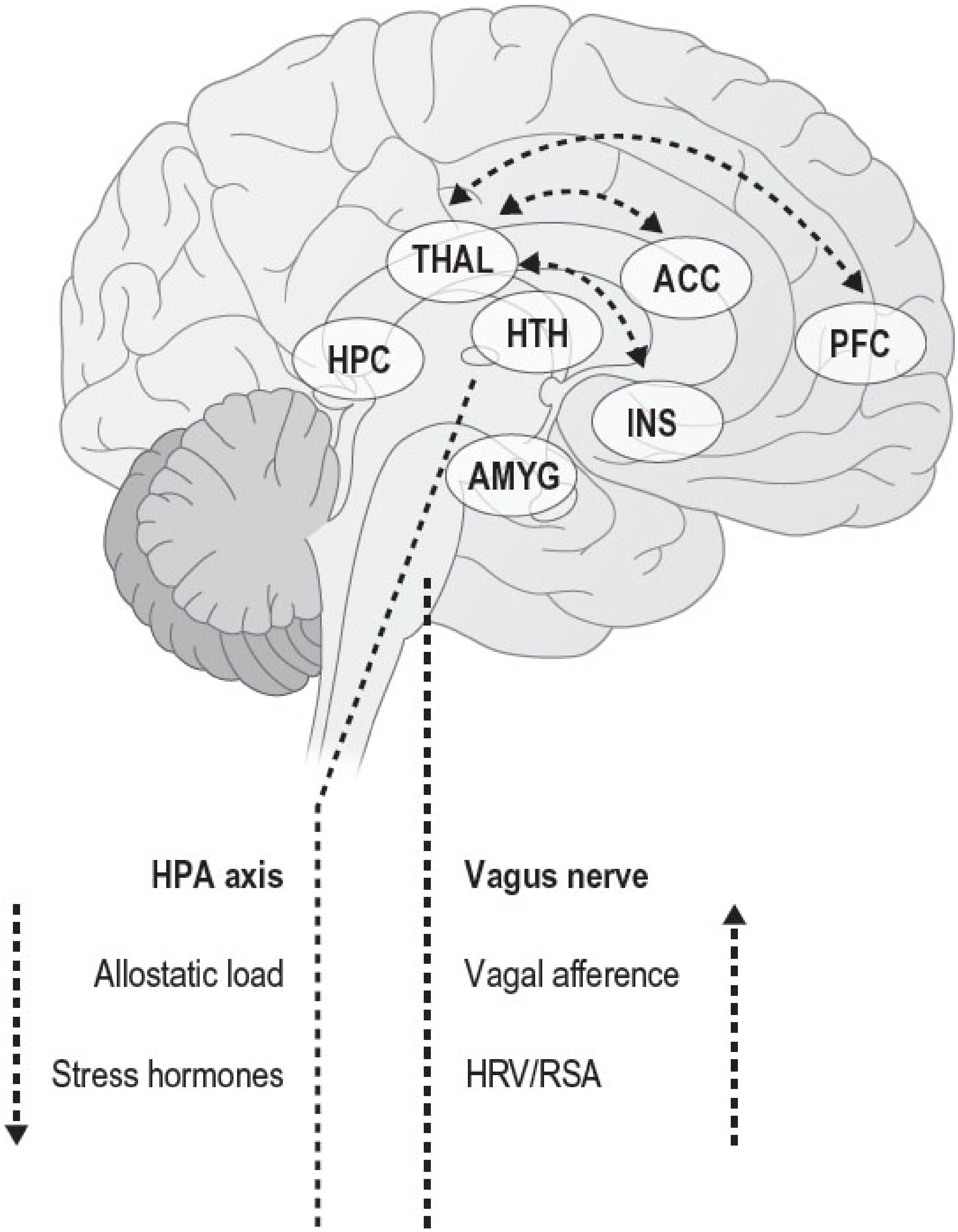

Figure 4.2
A schematic depiction of the integration of bottom-up and top-down processes. The breath employed in yoga-based practices (YBP) putatively promotes synchronization of cortical areas via stimulation of thalamic (THAL) nuclei, with a consequent positive

impact on alertness and executive functioning. In addition, slow and rhythmic breathing is known to promote vagal tone—reflected by increased heart rate variability (HRV)/respiratory sinus arrhythmia (RSA), and in turn reduce allostatic load—reflected by reduced release of stress hormones via the hypothalamic–pituitary–adrenal (HPA) axis, which originates in the hypothalamus (HTH). The THAL mediates vagal afferent information to the insula (INS), anterior cingulate cortex (ACC), and prefrontal cortex (PFC), which are all involved in self-regulatory processes. The amygdala (AMYG) supports fear-detection and consequent modulation of autonomic states. The hippocampus (HPC) contains stress hormone receptors that can influence the evaluation and memory of stress-related events.

One such weakness regards the use of self-selected populations and inappropriate control groups. Many of the studies have been done on either advanced practitioners (David et al., 2014; Villemure et al., 2014) or individuals participating in residential yoga programs (Gard et al., 2012; Telles et al., 1995), whereas control participants are often individuals with no yoga experience. Some of the reported physiological or behavioral differences may therefore be driven by pre-existing characteristics of individuals who are naturally inclined to engage in yoga-based practices (Gard et al., 2014b). In addition, many studies were conducted without the inclusion of an active control group (Fiori, David, & Aglioti, 2014; Froeliger, Garland, & McClernon, 2012).

A further weakness is that many studies documenting the effect of yoga-based practices on perceived levels of stress and emotional states are based on self-report measures alone (Malathi, Damodaran, Shah, Patil, & Maratha, 2000; Wood, 1993). This is problematic in the context of contemplative practices in particular, since the participants' perception and judgment of their own coping mechanisms are often changed as a result of the practices themselves (Grossman, 2008). Moreover, given the common belief about the positive impact of yoga on overall well-being, there is a danger of biased responses toward expecting, believing, and reporting beneficial effects (Grossman, 2008). More studies employing complementary assessment of behavioral, physiological, neural, and cognitive change are necessary.

Another limitation is that in many cases the protocols of the yoga interventions are not described with the necessary detail to allow for close experimental replication of the studies (Narayana, 2009; Rani & Rao, 1994). As mentioned throughout this chapter, most modern yoga-based practices involve a combination of movement, breath, relaxation, and meditation techniques, yet so far little if any research has attempted to deconstruct the role of these different component parts. It therefore remains unclear to what extent the individual component parts drive the overall outcomes, and whether their effect is synergistic in nature (Payne & Crane-Godreau, 2013).

Finally, there is a need for more studies that elucidate specific mechanistic hypotheses about the physiological and neural processes underlying the reported effects of yoga-based practices. If mechanistic hypotheses are provided, they often refer to general mechanisms known to underlie the effect of mindfulness-based practices (Froeliger, Garland, Modlin et al., 2012; Gard et al., 2012; Villemure et al., 2014). Recently proposed theoretical frameworks are an encouraging step forward (Gard, Noggle, Park, Vago, & Wilson, 2014; Henje Blom, Duncan et al., 2014; Schmalzl, Powers, & Henje Blom, 2015). The testing of hypotheses about the interaction between bottom-up physiological and top-down cognitive processes will be of particular interest, and require multidisciplinary approaches across the domains of physiology, neuroscience, and psychology.

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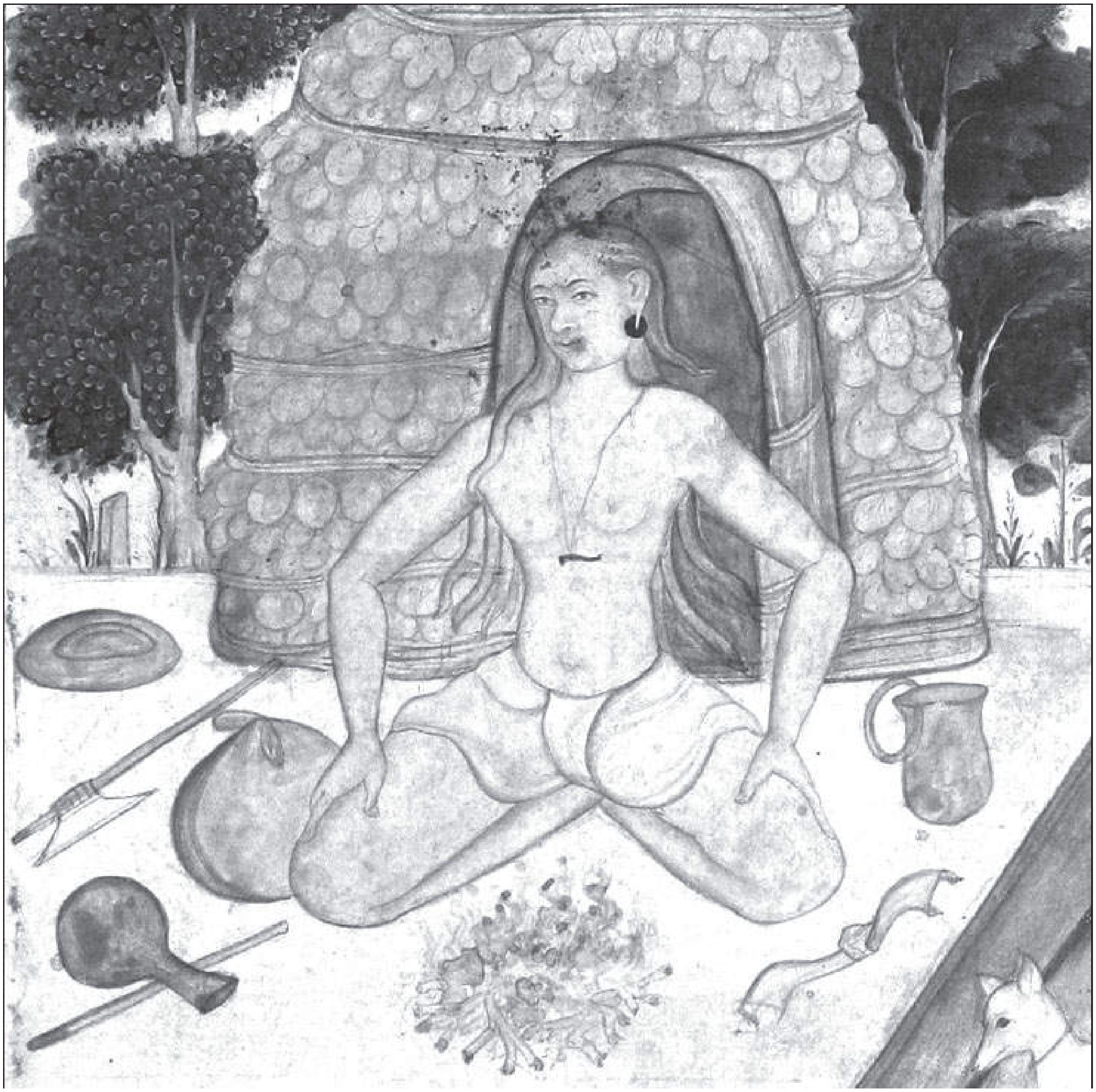
SECTION 2

MENTAL HEALTH CONDITIONS



From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.25b.

CHAPTER FIVE

YOGA THERAPY FOR DEPRESSION

L UEBELACKER • H LAVRETSKY • G TREMONT

Pathophysiology, etiology, and prevalence of depression

Definition and prevalence

Major depressive disorder (MDD) is defined as a period of 2 weeks or longer in which there is depressed mood or loss of interest or pleasure and at least four other symptoms involving changes in weight/appetite, sleep, activity level, energy, self-image, concentration, or suicidality. To meet diagnostic criteria, these symptoms must significantly impair social, occupational, or other functioning. MDD is one of the most common psychiatric conditions, estimated to affect 350 million individuals worldwide (World Health Organization, 2010). In 2012, 16 million adults in the United States had at least one depressive episode within the past year (Substance Abuse and Mental Health Services Administration, 2012). It is estimated that 20% of women and 12% of men will experience major depression in their lifetime.

Etiology and pathophysiology

Major depression is a complex biopsychosocial disorder, frequently co-occurs with anxiety disorders and substance use disorders (Kessler et al., 2003), and is likely clinically and etiologically heterogeneous (Hasler, 2010). Thus, many etiological hypotheses have been proposed. Considerable evidence suggests that alterations in metabolism of neurotransmitters such as serotonin, norepinephrine, or dopamine in the brain underlie the pathophysiology of depression (Belmaker & Agam, 2008). There is also evidence that acute depression is associated with decreased total gamma-aminobutyric acid (GABA) in the prefrontal and occipital cortex (Hasler et al., 2007). GABA is the primary inhibitory neurotransmitter in the brain.

Chronic stress (Roy & Campbell, 2013) and impaired emotion regulation (Compare, Zarbo, Shonin, Van Gordon, & Marconi, 2014)—which affects how one copes with stress—are risk factors for MDD. Thus, MDD is considered to be a stress-related disorder, and some individuals show dysfunction of the hypothalamic–pituitary–adrenal (HPA) axis and have heightened levels of the stress hormone cortisol (Pariante & Lightman, 2008). High levels of cortisol release and abnormalities in the stress response are hypothesized to account for associations between volume loss in the hippocampus (an important brain structure for learning and memory) and longer durations of episodes of depression (Sheline, Gado, & Kraemer, 2003). Relatedly, inflammatory-response activation has been implicated in depression. Elevated levels of proinflammatory cytokines, such as interleukin-1, interleukin-6, and tumor necrosis factor alpha, are seen in depression and associated with activation of the HPA axis and disruption of the central serotonin system (Dantzer, O'Connor, Freund, Johnson, & Kelley, 2008).

Genetic factors and heritability are implicated in depression. Estimates suggest that genes account for 30–40% of the variance in susceptibility to MDD, although there is little evidence for specific genes or gene-by-environment interactions (Donnelly, 2008; Kendler, Gardner, & Prescott, 2006). Environmental factors are also likely to increase susceptibility to or precipitate MDD. Specific environmental factors may include childhood traumatic events, interpersonal difficulties, interpersonal loss, isolation, and ongoing stressors. Psychological factors, such as increased anxiety and tendency to interpret events in negative ways, may also be related to depression. Similarly, cognitive biases and deficits in cognitive control may be associated with poor emotion regulation and are common in depressive disorders, and therefore could have implications for treatment strategies (Joormann & Quinn, 2014).

Psychophysiological rationale for the use of yoga for depression

Yoga practices may lead to beneficial changes in neurotransmitter systems, the neuroendocrine system (e.g., the HPA axis), and the immune system. As discussed above, these systems are implicated in the pathophysiology of depression and in a more general response to environmental stress. Thus, yoga may be a useful adjunctive or even primary treatment for depression.

Neurotransmitters, the autonomic nervous system, and yoga

Streeter and colleagues (2012) summarized biological mechanisms by which yoga may improve mental and physical health. Drawing on earlier work by McEwen and Stellar (1993), Streeter and colleagues hypothesized that environmental stress leads to imbalance of the autonomic nervous system (ANS) with decreased parasympathetic nervous system (PNS) and increased sympathetic nervous system (SNS) activity, which is associated with underactivity of the GABA system in the brain. Ultimately, this physiological response to environmental stress results in cumulative strain on or damage to different organs and tissues, especially the cardiovascular system. This strain is called “allostatic load”; allostatic load is thought to explain how increased stress is associated with disorders such as hypertension or atherosclerosis. Streeter hypothesized that yoga-based practices, and particularly practices that alter breathing patterns, increase activity of the PNS and GABA system in part via the afferent vagus nerves, which are the primary peripheral pathway of the PNS. Existing research suggests that yoga increases PNS activity (Streeter et al., 2012), and there is preliminary data suggesting that yoga increases GABA levels in the thalamus and that these increases are correlated with improved mood (Streeter et al., 2010).

Finally, there is also preliminary evidence that yoga practice can impact another neurotransmitter system involved in the regulation of mood, motivation, and reward/pleasure, all of which are impaired in depression. An imaging study has shown that yoga nidra is associated with increased endogenous dopamine release in the ventral striatum (Kjaer et al., 2002).

HPA axis and yoga

Increased HPA-axis activity, as indexed by cortisol levels at particular times of the day (e.g., awakening cortisol) and change in cortisol levels throughout the day, is another biological correlate of stress. Findings on the effects of yoga on cortisol levels are inconsistent (Li & Goldsmith, 2012). Studies have shown that yoga can reduce levels of plasma cortisol in individuals with depression (Devi, Chansauria, & Udupa, 1986) and alcohol abuse (Vedamurthachar et al., 2006), thus suggesting that yoga improves HPA-axis regulation. In a more recent study of yoga in women with breast cancer undergoing radiotherapy (Chandwani et al., 2014), yoga practice was associated with greater increases in physical functioning and quality of life over time compared with stretching or waitlist controls. Further, diurnal cortisol slope was steepest for the yoga group compared with the controls at follow-up, again indicating that yoga may help to regulate HPA-axis functioning. However, other studies have not found that yoga is associated with changes in cortisol levels (Corey et al., 2014; Sieverdes et al., 2014; Yoshihara, Hiramoto, Oka, Kubo, & Sudo, 2014).

Inflammation and yoga

Anti-inflammatory effects of yoga have also been highlighted in the growing number of studies on a variety of neuropsychiatric disorders. There is preliminary evidence that yoga practice has a positive impact on immune functioning, that is, in decreasing levels of biomarkers of inflammation (Pullen et al., 2008; Pullen et al., 2010; Rao et al., 2008; Sarvottam, Magan, Yadav, Mehta, & Mahapatra, 2013). For example, in a recent randomized clinical trial of hatha yoga versus waitlist control in breast cancer survivors, Kielcolt-Glaser et al. (2014) found that at posttreatment, fatigue was lower in the yoga group, vitality was higher, and levels of specific proinflammatory cytokines were lower for yoga participants compared with the control group. However, results are inconsistent: a recent meta-analysis (Morgan, Irwin, Chung, & Wang, 2014) of immune outcomes using a variety of mind–body interventions (tai chi, qi gong, meditation, or yoga) in 34 studies with 2,219 participants reported that mind–body interventions had a moderate effect on one important marker of inflammation (C-reactive protein) but small or no effects on other markers of inflammation or antiviral-related immune and enumerative measures (e.g., CD4 counts and natural killer cell counts).

Researchers are also starting to look at epigenetic changes (i.e., changes that alter gene expression but not DNA sequence) of immune cells involved in inflammatory and antiviral mechanisms. Black et al. (2013) compared 8 weeks of yogic meditation (specifically, Kirtan Kriya meditation) to relaxing music in a sample of 39 family caregivers of people with dementia. A comparison of gene expression profiles from the white blood cells of study subjects revealed reduced levels of inflammatory biomarkers in caregivers enrolled in the yogic meditation classes. This study suggests that it is possible that regular yoga practice may change gene expression to downregulate inflammatory pathways and improve protective viral immunity. Second, in a study comparing daily practitioners of mind–body practices that elicit relaxation to a group of nonpracticing controls, Dusek and colleagues (2008) found differences between groups in gene expression, with daily practitioners showing epigenetic changes that could serve to counter effects of stress on the body.

In conclusion**,** the field of yoga interventions used for mental health and depression is rapidly expanding and provides preliminary evidence linking pathophysiological mechanisms of depression to the mechanisms of response to yoga interventions. However, due to the wide variety of yoga practices and the wide variety of biomarkers studied, it is difficult to make definitive conclusions.

Review of published research

We conducted a review of the published randomized clinical trials of yoga for depression. We abstracted information about the specific nature of the population studied, specific types of yoga interventions used, specific outcome measures, whether and which adverse events were reported, quality of the research design, and whether the study specifically examined potential biomarkers that might link the practice of yoga to changes in the pathophysiology underlying depression.

Methods

Using the search terms “yoga” and “depression,” we identified potentially relevant abstracts from PubMed, PsychINFO, and CINAHL. This search yielded 243 abstracts on PubMed; we found an additional 23 unique abstracts from PsychINFO, and an additional eight unique abstracts on CINAHL. We also searched recent reviews of yoga for depression or psychiatric disorders; these did not yield any additional publications. From these abstracts, we identified randomized controlled trials (RCTs) of yoga that assessed its impact on depressive symptoms. We included trials of three distinct participant groups: (1) individuals with clinical depression (i.e., a diagnosis of MDD or persistent depressive disorder, which is defined by the presence of some depressive symptoms, more than half the time, for at least 2 years); (2) individuals with elevated depression symptoms, but no formal clinical diagnosis; and (3) women with prenatal depression. Although there are many trials of yoga in the context of a medical disease (e.g., cancer) that examined depression as an outcome but did not require elevated levels of depression at baseline, we did not include them in this review of original articles. The most robust test of yoga as a therapy for depression comes from studies in which participants are required to have some elevated level of depression at baseline.

For each eligible RCT, we abstracted information about the population, design and intervention outcome with regard to depression, adverse events, and quality of research design. We specifically assessed risk of bias in the research design and level of standardization of key aspects of the design. We used the Cochrane Handbook for Systematic Reviews of Interventions (Higgins, Altman, & Stern, 2011) to determine sources of bias to assess. We assessed risk of *selection bias* , or “biased allocation to interventions, due to lack of random sequence generation” or “lack of allocation concealment” (Higgins, Altman, & Stern, 2011). In order to have a *low* risk of selection bias, there must be some description of the random component of the sequence generation process and a description of procedures such that participants and investigators enrolling participants could not foresee assignment. Second, we assessed risk of *detection bias* due to “knowledge of the allocated interventions by outcome assessors” (Higgins, Altman, & Stern, 2011). In order to have low risk of selection bias, there must be a statement that the person assessing the outcome was blind to the intervention to which the participant was assigned. With one exception (in which two versions of a yoga intervention were used and participants were blind as to which version they received), blindness to intervention is not possible when the primary outcome is assessed by the participant him- or herself (i.e., using a self-report measure of depression). Third, we assessed risk of *attrition bias* due to “amount, nature, or handling of incomplete outcome data” (Higgins, Altman, & Stern, 2011). In order to have low risk of attrition bias, there must be either no missing data, or data are missing but the amount is relatively small, balanced in numbers across study arms, and intent-to-treat analysis is used.

There were two types of bias that we do not report on in our tables because the risk of bias is similar for all studies. *Reporting bias* is due to “selective outcome reporting,” that is, there being a bias toward reporting statistically significant (vs. nonsignificant) study results. Ideally, the study protocol would be available and/or the study would be registered in a clinical trials database. This would document a priori choice of primary and secondary outcome variables, and allow one to assess reporting bias. However, many of the studies were conducted prior to the common use of clinical trials registries. Therefore, risk of reporting bias is unclear for all studies. Finally, almost all studies of behavioral interventions suffer from risk of *performance* bias—that is, the risk that there are systematic differences between groups other than the intervention provided. Being able to blind participants and study staff to allocated intervention reduces risk of performance bias, but this typically is not possible in the context of trials of behavioral interventions such as yoga.

We also assessed standardization of three key components for each RCT: whether investigators used a standardized interview to diagnose depression; whether investigators used a standard measure of depression with documented acceptable psychometric properties to assess outcome; and whether there was a manual or very clear set of procedures for yoga instructors that would allow the yoga intervention to be understood and replicated.

Yoga for clinical depression

We identified seven RCTs of yoga for clinical depression (Broota & Dhir, 1990; Butler et al., 2008; Janakiramaiah et al., 2000; Kinser, Bourguignon, Whaley, Hauenstein, & Taylor, 2013; Rohini, Pandey, Janakiramaiah, Gangadhar, & Vedamurthachar, 2000; Sarubin et al., 2014; Sharma, Das, Mondal, Goswami, & Gandhi, 2005). Please see Table 5.1 (p. 80) for a description of the trials.

The type, duration, and frequency (i.e., "dosage," or minutes per week) of yoga varied widely. Styles of yoga used included yoga primarily focused on pranayama (e.g., Sudarshan Kriya Yoga), yoga focused on meditation (e.g., Sahaj yoga), and hatha yoga that included a combination of pranayama exercises, asana practice, and meditation. The duration of the yoga interventions ranged from 3 days to 4–5 weeks to 8 weeks. Frequency of yoga practice varied, from one class per week to daily, with some studies asking participants to engage in daily home practice. Most studies used some type of manual or detailed set of procedures for yoga instructors; however, no studies documented that investigators assessed whether instructors actually followed those procedures.

As can be seen in Table 5.1 (p. 80), other characteristics of the trials and methodological rigor varied widely. Control/comparison groups included no treatment, psychoeducation or health education, a "partial" version of the yoga intervention, electroconvulsive therapy, and antidepressant medications. Although most studies used a standardized measure of depression as an outcome, no studies documented interrater reliability of assessment interviews. Only two studies documented that depression-outcome raters were blind to treatment group, resulting in most studies having a high risk of detection bias. No studies documented clearly adequate randomization procedures, resulting in all studies having a high risk of selection bias. No studies with documented dropouts used intent-to-treat analyses. Finally, most trials had relatively small sample sizes; sample sizes ranged from 27 to 60. Thus, it is very likely that most trials were underpowered to detect anything but a large difference in depression outcomes between groups.

Of the seven studies reviewed, only three found that yoga was superior to a comparison group on a depression outcome at endpoint or follow-up (Broota & Dhir, 1990; Butler et al., 2008; Sharma et al., 2005). However, given the heterogeneity of trials and methodological limitations of the literature as a whole, we cannot draw firm conclusions regarding efficacy. Safety and adverse events were documented in only two of the seven studies, both of which reported no clinically significant side effects. Therefore, it is not possible to draw firm conclusions about the safety of yoga for clinical depression either.

Finally, only one study examined potential biological mechanisms. Sarubin et al. (Sarubin et al., 2014) failed to find differences between groups over time in indices of HPA-axis activation. Note, however, that they used a complex design and all participants received one of two antidepressant medications.

Yoga for individuals with elevated depression symptoms

We identified five RCTs of yoga for this group (Khumar, Kaur, & Kaur, 1993; Lavretsky et al., 2013; Shahidi et al., 2011; Veale et al., 1992; Woolery, Myers, Sternlieb, & Zeltzer, 2004). Please see Table 5.2 , p. 82. Each of the five trials used very different types of yoga intervention: “low-intensity” exercise that included yoga postures, an extended period of shavasana (corpse pose only), Iyengar yoga, laughter yoga, and Kirtan Kriya practice. The length of the intervention period ranged from 4 weeks to 12 weeks. Only two studies documented use of a manual or provided detailed description of yoga procedures. Control/comparison groups included no intervention, waitlist control, relaxation, and aerobic exercise. As can be seen in Table 5.2 (p. 82), although studies did use a standardized measure of depression as an outcome measure, these studies suffered from numerous methodological limitations as well that resulted in high or unclear risk of bias. Two studies specifically excluded individuals with clinical depression, thus making it hard to generalize their results to a group of people with clinical depression.

Adverse events were not discussed in any of the reports. With regard to efficacy, three of the five studies showed that yoga was superior to a control group (including waitlist, no treatment, or listening-to-music relaxation) in terms of the primary outcome of depressive symptom severity (Lavretsky et al., 2013; Shahidi et al., 2011; Woolery et al., 2004). Two studies compared yoga to aerobic exercise; neither found differences between yoga and exercise.

Two of the five studies examined biomarkers. In one study of yoga versus a waitlist control, there were no significant differences in awakening cortisol levels between the two groups at endpoint (Woolery et al., 2004). Lavretsky and colleagues (Lavretsky et al., 2013) examined a biomarker, telomerase activity, that is thought to link chronic stress to the cellular aging processes. Their meditative yoga program, relative to a relaxation program, was associated with changes in telomerase activity consistent with improvements in stress-related cellular aging.

Yoga for depressed pregnant women

We identified four RCTs of yoga for clinically depressed pregnant women (Field, Diego, Delgado, & Medina, 2013a, 2013b; Field et al., 2012; Mitchell et al., 2012) (Table 5.3). All four studies were conducted in the same location by the same group of investigators. Thus the hatha yoga intervention was similar (and documented in the form of a list of asanas used) across at least three of the studies (except for one study that described a combined tai chi–yoga intervention). The yoga intervention was unusual in that the dosage was very low: it included one 20-minute session per week for 12 weeks (except for Mitchell et al., 2012, who described two 20-minute sessions per week). These investigators compared prenatal yoga to a range of control/comparison conditions. Methodological strengths included the use of a standardized diagnostic interview to determine whether participants had MDD or persistent depressive disorder that did not meet criteria for MDD (formerly called dysthymia), as well as the use of a standardized measure of depression outcome. However, risk of selection, detection, and attrition bias was unclear or high in most cases.

Regarding efficacy, the yoga intervention was superior to the parenting education, waitlist control, and standard prenatal-care-only comparison groups in terms of depression outcomes and was not different from the social-support control group or massage therapy. None of the reports discussed adverse events. One study (Field et al., 2013b) examined an index of HPA-axis activity, namely, midmorning salivary cortisol levels, and failed to find differences between the yoga group and the control group (social support) in changes over the 12-week intervention period.

Other reviews

Meta-analysis of yoga for depression

A recent meta-analysis of the impact of yoga on depression-symptom severity included 12 of the 16 RCTs reviewed above (Cramer, Lauche, Langhorst, & Dobos, 2013). These authors reached conclusions similar to what we describe here. First, they found that only three of the 12 articles had low risk of bias. Second, they stated that no RCTs reported safety data. Third, results of their meta-analyses suggested moderate and statistically significant effect-size differences in short-term depression outcomes, favoring yoga versus usual care (standardized mean difference (SMD) = 0.69); yoga versus relaxation (SMD = 0.62); and yoga versus aerobic exercise (SMD = 0.59.) Of the four studies *not* included in their analyses, two were positive, favoring yoga (Field et al., 2013a; Mitchell et al., 2012), and two failed to find differences between yoga and a control/comparison group (Kinser et al., 2013; Sarubin et al., 2014).

Yoga and depressive symptoms in other medical conditions

Depressive symptoms have been assessed as a secondary outcome in studies of yoga in either healthy (nondepressed) adults or in the context of other medical problems. We were able to find three systematic reviews and meta-analyses that examined depression-symptom severity as a secondary outcome in RCTs. These reviews suggest that yoga is associated with large reductions in depression symptoms among cancer patients and survivors (Buffart et al., 2012) and moderate reductions in depression symptoms among people with fibromyalgia (Hassett et al., 2007; Langhorst, Klose, Dobos, Bernardy, & Hauser, 2013). In contrast, evidence for the impact of yoga on depressive symptoms in a general older adult population is mixed (Patel, Newstead, & Ferrer, 2012).

Summary and conclusions, clinical relevance, future research directions

Although published research is promising in terms of the impact of yoga on depression-symptom severity relative to usual care or minimal-treatment controls, it is difficult to draw firm conclusions about efficacy or safety at this point. It is also difficult to draw conclusions about what biological pathways may underlie the impact that yoga might have on depression. There are several reasons that firm conclusions are elusive: (1) the heterogeneity of type of yoga employed, intensity (dosage) of intervention, and length of intervention in existing studies; (2) the heterogeneity of control interventions employed; (3) the high risk for bias in much of the existing research; and (4) the fact that most studies did not report any information about safety. We recommend that future research employ a rigorous RCT methodology with individuals with MDD as assessed using a standardized interview; blind-outcome assessors; a yoga protocol that employs specific practices thought to impact the underlying pathophysiology of depression; and an intervention period similar to that found in other trials of acute treatment for depression (i.e., 8–12 weeks). The yoga protocol should be described in sufficient detail that it can be replicated. Another option is to make use of technology (e.g., smartphone apps, online videos) that can help to standardize either training teachers in interventions or that can serve as the standardized intervention itself. In addition to safety assessments related to potential physical health problems associated with yoga (e.g., pain or injury), we recommend that future research systematically assess for potential psychiatric adverse events, including incidence of hypomania/mania, psychosis, or suicidal ideation.

Further, in any research design, it will be important to give careful thought to choice of control group, because that will determine what can be concluded about whether specific aspects of yoga impact depression. Control groups that include stretching or walking (or other mild-to-moderate physical activity) may control for aspects of yoga that are not unique to yoga, allowing one to test whether yoga-specific physical movement has an effect on depression beyond the effect of physical activity. Other types of control groups, such as health education, may control for the social effects of being in a class with others, or even the impact of leaving the house and participating in a healthy activity. These may be important considerations, because social support and behavior activation can have an impact on depression.

Finally, in order to better understand the biological mechanisms by which yoga may have an impact on depression, future RCT designs may include measurement of GABA or other key neurotransmitters, HPA-axis activation and biomarkers of inflammation, and other important biomarkers of stress response and neuroplasticity. At this point, these types of biomarkers seem the best candidates for targeted studies. Studies may test whether employing specific yoga practices impact specific mechanisms. For example, there is some evidence that specific breath practices have a positive impact on heart rate variability, an index of autonomic nervous system functioning (Hassett et al., 2007).

Clinical relevance

We close with advice for the individuals suffering from depression and their clinicians and family. Given the quality of the existing evidence, we believe a measured approach is warranted. That is, if individuals would like to try yoga as a way to cope with depression symptoms, they might discuss this with a treating clinician, try a class that seems appealing, attend the class regularly for 8–10 weeks, and take notice of how they feel both during and after classes and over the 8–10 weeks. It might be helpful for individuals to avoid other changes in depression treatment, such as ceasing medication, while investigating the effects of yoga. Another person such as a primary care physician or family member may be useful in evaluating the usefulness of yoga as part of the treatment for depression. There are many different styles and approaches to yoga, and if after some time no effect has been observed in depression symptoms, the practitioner might try a class with a different emphasis. One-on-one yoga instruction with a yoga therapist may also be helpful in that it can be tailored to the individual. It is possible that increased frequency (e.g., yoga classes twice per week instead of once, or brief practices at home in addition to class) will result in a greater reduction of depression symptoms, but there is no definitive research to support that proposition yet. Given the research available, there is reason to believe that yoga may be helpful in alleviating depression for many people; however, each individual will need to evaluate yoga practices for him or herself.

Table 5.1 Characteristics of randomized clinical trials including participants with clinical depression

Reference	Population	Design and interventions	Outcome	Adverse events related to yoga	Risk of bias and standardization
Broota & Dhir, 1990	30 depressed psychiatric outpatients	3-arm RCT: Broota relaxation technique (based on yoga, includes four postures and pranayama) vs. progressive muscle relaxation vs. no treatment. Length of intervention: 3 days	At endpoint, yoga group had fewer depressive symptoms than no treatment group on a depression symptom checklist	Not discussed	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – high (7% dropout rate; no intent-to-treat analyses) Standardized diagnostic interview – no Depression outcome using standardized measure – no Manual/detailed procedures for yoga instructor – yes
Janakiramaiah et al., 2000	45 hospitalized patients with DSM-IV melancholic depression	3-arm RCT: Sudarshan Kriya Yoga (SKY), which includes pranayama and yoga nidra vs. electroconvulsive therapy (ECT) vs. imipramine. Length of intervention: 4 weeks	At endpoint, ECT was superior to SKY; SKY and imipramine not significantly different on HRSD	"No clinically significant side effects (e.g., seizures, confusion, cardiovascular accidents, hypomanic switch)"	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – unclear (unclear whether HRSD conducted by blind evaluators) Risk of attrition bias – low (no dropouts) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (HRSD) Manual/detailed procedures for yoga instructor – yes
Rohini, Pandey, Janakiramaiah,	30 patients with DSM-IV MDD	2-arm RCT: full SKY vs. "partial" SKY (which did not include a key	At endpoint, no differences	Not discussed	Risk of selection bias – unclear (no details about randomization)

Gangadhar, & Vedamurthachar, 2000		breathing component). Length of intervention: 4 weeks	between groups on BDI		Risk of detection bias – low (participants blind to treatment group; depression rated by self-report) Risk of attrition bias – low (no dropouts) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (BDI) Manual/detailed procedures for yoga instructor – yes
Sharma, Das, Mondal, Goswami, & Gandhi, 2005	30 patients with DSM-IV MDD	2-arm RCT: Sahaj yoga (meditation) vs. attention control (sitting quietly). All participants received antidepressants. Length of intervention: 8 weeks	Over 8 weeks, yoga > control group in changes in depressive symptoms (on HRSD) over time	"No significant clinical side effects (confusion, cardiovascular accidents, hypomanic switch, etc.)"	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – unclear (unclear whether HRSD conducted by blind evaluators) Risk of attrition bias – low (no dropouts) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (HRSD) Manual/detailed procedures for yoga instructor – yes
Butler et al., 2008	46 participants with chronic depression (i.e., MDD for > 2 years or dysthymia)	3-arm RCT: hatha yoga + meditation + psychoeducation vs. group therapy + hypnosis + psychoeducation vs. psychoeducation alone (control	No assessments at 12 weeks. Yoga > control on % remitted at 9 months (assessed via SCID). No differences between groups in	Not discussed	Risk of selection bias – high (computer-generated random sequence; sequence not concealed) Risk of detection bias – low (SCID conducted by blind evaluators)

		group). Length of intervention: 12 weeks	change in HRSD-26 item over 9 months		Risk of attrition bias – high (12% dropout rate; no intent-to-treat analysis) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (SCID) Manual/detailed procedures for yoga instructor – yes
Kinser, Bourguignon, Whaley, Hauenstein, & Taylor, 2013	27 women with MDD or dysthymia	2-arm RCT: gentle hatha yoga vs. health and wellness program. Length of intervention: 8 weeks	No differences between groups in change over time on PHQ-9	Not discussed	Risk of selection bias – unclear (computer generated random numbers; unclear if allocation concealment) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – low (26% dropout rate; data analyses used multilevel models with multiple timepoints, so likely all included in analyses) Standardized diagnostic interview – yes (MINI) Depression outcome using standardized measure – yes (PHQ-9) Manual/detailed procedures for yoga instructor – yes
Sarubin et al., 2014	60 inpatients with MDD	2 2 RCT: hatha yoga vs. no yoga; quetiapine vs. escitalopram.	No differences between hatha yoga and no yoga group in	Not discussed	Risk of selection bias – unclear (Details about randomization unclear)

		Length of intervention: 5 weeks	rates of response (i.e., 50% decrease in HRSD-21 item) at endpoint		Risk of detection bias – unclear (unclear if HRSD conducted by blind evaluator) Risk of attrition bias – high (12% attrition; completer analysis presented) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (HRSD) Manual/detailed procedures for yoga instructor – no

BDI: Beck Depression Inventory; DSM-IV: Diagnostic and Statistical Manual, 4th edn; ECT: electroconvulsive therapy; HRSD: Hamilton Rating Scale for Depression; MDD: major depressive disorder; MINI: Mini International Neuropsychiatric Interview; PHQ-9: Patient Health Questionnaire, 9 item; RCT: randomized controlled trial; SCID: Structured Clinical Interview for DSM-IV; SKY: Sudarshan Kriya Yoga.

Table 5.2 Characteristics of randomized clinical trials including participants with elevated depressive symptoms

Reference	Population	Design and interventions	Outcome	Adverse events related to yoga	Research design
Veale et al., 1992	89 participants with elevated depressive symptoms on the Clinical Interview Schedule (CIS)	2-arm RCT: "Low intensity" exercise that included stretching, relaxation, and yoga vs. aerobic exercise. Length of intervention: 12 weeks	No differences between groups on CIS or BDI at week 12	Not discussed	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – high (24% dropout rate; no intent-to-treat analyses) Standardized diagnostic interview – yes (CIS) Depression outcome using standardized measure – yes (BDI) Manual/detailed procedures for yoga instructor – no
Khumar, Kaur, & Kaur, 1993	50 female postgraduate students with "severe" depression as assessed using a few different methods	2-arm RCT: shavasana (corpse pose) only, 30 minutes per day) vs. no intervention. Length of intervention: 30 days	No direct statistical comparison between groups	Not discussed	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – low (no dropouts) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (ZDSRS) Manual/detailed procedures for

					yoga instructor – no
Woolery, Myers, Sternlieb, & Zeltzer, 2004	28 college students with BDI scores between 10 and 15. Excluded people with a "current psychiatric diagnosis"	2-arm RCT: Iyengar yoga vs. waitlist control group. Length of intervention: 5 weeks	Yoga > control group in reductions in depression symptoms over 5 weeks	Not discussed	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – high (18% dropout rate; no intent-to-treat analysis) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (BDI) Manual/detailed procedures for yoga instructor – no
Shahidi et al., 2011	70 depressed older women (GDS score > 10)	3-arm RCT: laughter yoga vs. exercise therapy vs. no-treatment control. Length of intervention: unclear	Yoga > control group in reductions in depression symptoms over time. Yoga not different from exercise therapy	Not discussed	Risk of selection bias – unclear (no details about randomization) Risk of detection bias – high (primary outcome = self-report) Risk of attrition bias – high (14% dropout rate; no intent-to-treat analysis) Standardized diagnostic interview – no Depression outcome using standardized measure – yes (GDS) Manual/detailed procedures for yoga instructor – yes
Lavretsky et al., 2013	39 family dementia	2-arm RCT: Kirtan Kriya practice vs.	At 8 weeks, yoga > control group	Not discussed	Risk of selection bias –

	caregivers; HRSD-24 items scores between 5–17; people with MDD excluded	listening-to-music relaxation. Length of intervention: 8 weeks	on % of participants with response (50% improvement) on HRSD		low (computer-generated randomization table; randomized by a masked statistician) Risk of detection bias – unclear (unclear if HRSD conducted by blind evaluator) Risk of attrition bias – high (20% dropout rate, no intent-to-treat analysis) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (HRSD) Manual/detailed procedures for yoga instructor – yes

BDI: Beck Depression Inventory; CIS: Clinical Interview Schedule; GDS: Geriatric Depression Scale; HRSD: Hamilton Rating Scale for Depression; RCT: randomized controlled trial; SCID: Structured Clinical Interview for DSM-IV; ZDSRS: Zung Depression Self-Rating Scale.

Table 5.3 Characteristics of randomized clinical trials including participants with prenatal depression

Reference	Population	Design and interventions	Outcome	Adverse events related to yoga	Research design
Mitchell et al., 2012	24 pregnant women; met criteria for depression on SCID	2-arm RCT: prenatal hatha yoga vs. parenting education. Length of intervention: 12 weeks	Yoga > parenting education in decreases in CES-D scores over time	Not discussed	Risk of selection bias – unclear (No details about randomization) Risk of detection bias – high (Primary outcome = self-report) Risk of attrition bias – low (No dropouts) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (CES-D) Manual/detailed procedures for yoga instructor – yes ("Routine" [list of asanas] provided)
Field, Diego, Delgado, & Medina, 2013a	92 pregnant women; met criteria for dysthymia or MDD on SCID	2-arm RCT: tai chi/yoga vs. waitlist control. Length of intervention: 12 weeks	Tai chi/yoga > waitlist control in decreases in CES-D scores over time	Not discussed	Risk of selection bias – unclear (No details about randomization) Risk of detection bias – high (Primary outcome = self-report) Risk of attrition bias – high (18% attrition, No intent-to-treat analyses) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (CES-D)

					Manual/detailed procedures for yoga instructor – no
Field, Diego, Delgado, & Medina, 2013b	92 pregnant women; met criteria for dysthymia or MDD on SCID	2-arm RCT: prenatal hatha yoga vs. social support group. Length of intervention: 12 weeks	No significant differences between groups in change in CES-D scores over time	Not discussed	Risk of selection bias – unclear (Used random numbers table; no details about allocation concealment) Risk of detection bias – high (Primary outcome = self-report) Risk of attrition bias – high (14% attrition, No intent-to-treat analyses) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (CES-D) Manual/detailed procedures for yoga instructor – yes
Field et al., 2012	84 pregnant women; met criteria for dysthymia or MDD on SCID	3-arm RCT: prenatal hatha yoga vs. massage therapy vs. standard prenatal care only. Length of intervention: 12 weeks	Yoga > standard prenatal care in decreases in CES-D scores over time. No significant differences between the yoga group and massage therapy group	Not discussed	Risk of selection bias – unclear (No details about randomization) Risk of detection bias – high (Primary outcome = self-report) Risk of attrition bias – high (25% attrition, No intent-to-treat analyses described.) Standardized diagnostic interview – yes (SCID) Depression outcome using standardized measure – yes (CES-D)

		Manual/detailed procedures for yoga instructor – yes (“Routine” [list of asanas] provided)

CES-D: Center for Epidemiologic Studies – Depression Scale; MDD: major depressive disorder; RCT: randomized controlled trial; SCID: Structured Clinical Interview for DSM-IV.

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DEPRESSION: CLINICAL INSIGHTS

TIMOTHY MC CALL IN COLLABORATION WITH THE CONSULTING YOGA TEACHERS AND YOGA THERAPISTS

"In depression," says Patricia Walden, "there can be a lack of physical and emotional grounding, exhibited by shallow breathing, physical tension in the abdomen, diaphragm, shoulders, and throat." Ganesh Mohan observes what he calls a "posture of depression," which includes rounded shoulders, lowered head, and a collapsed spine.

"For many people suffering from depression there is often a mixed affect, because depression and anxiety often are co-occurring disorders," notes Amy Weintraub. "The person may feel hopeless or physically lethargic, and yet there may be an agitated state of mind, most commonly associated with anxiety." Similarly, Anukool Deval notes that patients who are depressed often get lost in their thoughts, have trouble concentrating, and hence may have difficulty remembering the yoga program. Walden says that, in yoga poses, "the person can have trouble being fully present in his or her body."

Walden says, "I work with asanas that are grounding, calming, and uplifting, focusing first on stability in the body—and then the breath." She uses different yoga sequences, depending on the circumstances. She finds that such supine supported backbends as reclined bound-angle pose (*supta baddha konasana*), with the back supported by a bolster, are useful in reversing the slumping posture so common in depression. The bolster can be placed longitudinally along the spine (see Fig. 5.1A) or, in cases where there is concomitant anxiety or tension in the abdominal muscles, perpendicular to the spine (see Fig. 5.1B).

Mohan uses gentle flowing sequences, similarly emphasizing “chest opening,” to reverse the posture of depression. “I would watch the person’s breathing [during asana practice] and encourage them to breathe as freely and comfortably as possible on the inhale and the exhale, guiding them toward a relatively equal inhale: exhale ratio.” In other words, if the person inhales for three seconds, he or she should try to exhale for the same length of time.

Walden finds that inversions such as handstand, headstand (*sirsasana*), shoulderstand (*sarvangasana*), plow pose (*halasana*), and bridge pose (*setu bandha*) foster “mental and emotional stability.” For students who are less experienced with inversions, Walden often uses downward-facing dog pose (*ahdo muhka svanasana*) with the head supported by folded blankets or a block and/or wide-legged standing forward bend (*prasarita padattonasana*) with head support (see Fig. 22.18 , p. 509).

Deval reports that it is desirable to keep the patient’s “mind always engaged while practicing yoga,” to prevent too much rumination, which may be counterproductive. To prevent such brooding, Walden will sometimes suggest keeping the eyes open in restorative poses and corpse pose (*savasana*).

Timothy McCall believes that “in the long-run, meditation may be one of the most powerful tools to fight depression, but it is not always appropriate for those who are acutely depressed.” Mohan reports, “Non-directional internally focused meditative or contemplative practices may be risky. The tendency toward rumination can lead to the problem worsening when attention is directed solely inward without a concrete way to oppose negative thoughts and emotions.” As an alternative, he says, “Mantra meditation is a useful mental support.” Otherwise, if Mohan uses mindfulness meditation as part of the practice, he recommends “keeping part of the focus grounded outward – eyes open and aware of the surroundings – to prevent the person from falling into rumination of their old thoughts and feelings.”


A


B

Figure 5.1 A, B

Two versions of reclining cobbler’s pose (supta baddha konasana) used for depression. Note that the folded blankets placed under the legs help facilitate relaxation by letting the groins relax.

Photographs by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Pranayama is often helpful in combating depression, finds Walden. She has had good luck with victorious breath (*ujjayi*), with the focus on inhalation. She has less-experienced students do the practice lying down with the chest supported by folded blankets, while more-experienced students can do it seated. For more-seasoned students, she also sometimes recommends *antara kumbhaka* , briefly holding the breath after the inhalation.

Weintraub often begins with a restorative chest-opening pose, to which she adds yogic three-part (sectional) breathing, dividing either the inhalation or exhalation into three sections, with a brief pause in between each part. For students who cannot breathe deeply—common in depression and anxiety—she has developed a variation she calls “stair-step breath.” In this practice, done either seated or supine, students can take anywhere from 3 to 10 “little steps of breath through the nostrils, as though climbing a mountain.” When they’ve finished, they can “slide down the mountain” to exhale in naturally slow manner. After a few rounds, she switches to dividing the exhalation into parts, instructing them on an inhalation to “take an elevator up to the top of the mountain” and on the exhalation to “take little steps down the mountain.” Weintraub has found this language helpful, because “many suffering from an anxiety-based depression who are new to yoga breathing tense up when told to breathe. This imagery circumvents the anxious mind's often-held belief that it can't control or slow the breath."

As useful as pranayama can be, there are also contraindications in its use with depressed individuals. Walden states, "I would not do *bahya kumbhaka* [retention after exhalation], as this can make the depressed person feel emptier or stimulate feelings of loss." Mohan says, "Strong breathing practices should be done with caution. Though inhale emphasis might be energizing, too much may trigger underlying anxiety or leave the person feeling physically energized but mentally somewhat disassociated." Although Weintraub sometimes finds strong breathing practices like *kapalabhati* (skull-shining breath) and *bhastrika* (bellows breath) energizing for patients with depression, she often favors milder practices like stair-step breath, which she believes have lower risk of "triggering anxiety, a manic or hypomanic episode [in those with bipolar disorder], or agitation to the [ayurvedic] *pitta* constitution."

Walden finds that "the study of spiritual teachings can be uplifting." Although she normally does not recommend listening to music while practicing yoga, she believes it can sometimes be useful in those who are depressed. For those students who are open to it, she finds chanting to be particularly valuable.

McCall mentions a practice that comes from Patanjali's *Yoga Sutras, pratipaksha bhavanam* , or "cultivating the opposite." He says, "When feelings of sadness or depression arise, try to focus on something or someone you are grateful for. This is not just 'the power of positive thinking' but rather because no matter how bad things seem, each of us has many genuine reasons to feel gratitude." Mohan adds, "Gratitude and appreciation practices can be introduced according to the comfort of the individual, either in writing, or as verbal affirmations, or along with mantra or mindfulness." Walden sometimes asks depressed students to write in a journal a list of things they are grateful for and to review that list, adding one new entry, every day.

Resources

Book: The Woman's Book of Yoga and Health by Linda Sparrowe and Patricia Walden

Book: Yoga for Depression by Amy Weintraub

Book: Yoga as Medicine by Timothy McCall (chapter on depression features Patricia Walden's approach)

CHAPTER SIX

YOGA THERAPY FOR ANXIETY

K PILKINGTON • PL GERBARG • RP BROWN

Prevalence of anxiety disorders

Anxiety disorders, obsessive-compulsive and related disorders (OCD), and trauma- and stressor-related disorders are among the most commonly occurring mental disorders worldwide and include conditions such as generalized anxiety disorder (GAD), panic disorder, phobias, acute stress disorder, and posttraumatic stress disorder (PTSD). Anxiety and trauma-related disorders often cause feelings of panic, fear, and intrusive thoughts and may result in interrupted sleep, difficulty functioning at work, disturbances in relationships, and physical symptoms (American Psychiatric Association, 2013). GAD is characterized by constant and excessive anxiety about many aspects of daily life, including health, money, and family and work issues (Stein & Sareen, 2015). There may also be an overwhelming feeling of impending disaster. OCD involves persistent and unwanted feelings or thoughts (obsessions) accompanied by rituals or repetitive behavior such as hand-washing (compulsions) or constant checking carried out in an attempt to control these thoughts (American Psychiatric Association, 2013). Phobias and panic disorder involve intense feelings of fear. Panic disorder involves recurrent and sudden unprovoked episodes, each referred to as a "panic attack" (American Psychiatric Association, 2013). In phobias, the feelings of fear are provoked by particular items, such as spiders or flying (specific phobias) or social situations (social anxiety disorder or social phobia) (Combs & Markman, 2014). PTSD describes a condition following severe physical or emotional trauma, in which reminders of the experience seriously affect thoughts and behavior over a prolonged period of time (American Psychiatric Association, 2013).

Estimates of lifetime prevalence range from 6–12% for specific phobias; 3–5% for GAD; 2–5% for panic disorder, and 2–3% for OCD. Due to variance in trauma exposure, estimates of lifetime prevalence of PTSD differ among countries: 1–2% in Western Europe, 6–9% in North America, and greater than 10% in countries with long-term sectarian violence (Kessler, Berglund, et al., 2005). In a given year, about 18% of American adults and about 8% of adolescents (ages 13–18 years) experience an anxiety disorder. Symptoms commonly appear around age 6–11 years (Kessler, Chiu, Demler, Merikangas, & Walters, 2005).

Pathophysiology and etiology of anxiety disorders

Genetic, environmental, psychological, and developmental factors contribute to anxiety disorders. Stress and trauma play key roles in the development of anxiety disorders and in the triggering of anxiety symptoms. Anxiety disorders are manifestations of dysfunction in stress-response systems (SRS): the autonomic nervous system (ANS) and the hypothalamic–pituitary–adrenal axis (HPA). Overactivity or erratic activity in the sympathetic nervous system (SNS) and underactivity in the parasympathetic nervous system (PNS) have been documented in anxiety disorders (Porges, 2007; Thayer, Hansen, Saus-Rose, & Johnsen, 2009). These imbalances have widespread effects on emotion regulation; perception; cognitive function; social relationships; and the functioning of the cardiovascular, respiratory, gastrointestinal, neuroendocrine, immunological, and other systems (Brown, Gerbarg, & Muench, 2013; Carter et al., 2013; Porges, 2009).

Fear-processing circuits in the brain include the higher centers (e.g., prefrontal cortex and insular cortex), the thalamus, and the lower centers (amygdala and hippocampus). Physical and psychological symptoms of anxiety may be generated when the higher centers fail to adequately modulate overreactivity in the amygdalar–hippocampal complex.

Psychophysiological rationale for the effects of yoga on anxiety disorders

Yoga may ameliorate pathophysiological processes that contribute to anxiety disorders through both top-down and bottom-up mechanisms by:

- Balancing stress-response systems, reducing sympathetic overactivity, and increasing parasympathetic underactivity
- Reducing overactivity in the limbic system and dysfunction in emotion regulatory circuits
- Increasing the capacity of higher brain centers to modulate lower brain centers
- Improving cognitive functions and correction of misappraisals of threat
- Activating interoceptive inputs to key brain regulatory centers: limbic system, thalamus, prefrontal cortex, insular cortex, and hypothalamus

- Improving efficiency and integration of top-down and bottom-up neurophysiological networks
- Reducing internally generated, ruminative anxious thoughts and worries
- Enhancing feelings of connectedness, bonding, and safety via interoceptive autonomic pathways and prosocial, antianxiety neurohormone release.

Numerous studies have shown that yoga practices, particularly breathing practices (e.g., pranayama), can have rapid normalizing effects on the autonomic nervous system (ANS). In addition, voluntarily regulated breathing practices (VRBPs), technology-assisted paced breathing, biofeedback, and other breath-oriented mind–body programs, such as yoga, qigong, and Breath-Body-Mind, have been shown to improve sympatho–vagal balance and significantly reduce symptoms in stress-related anxiety, GAD, PTSD, phobias, and social anxiety (Brown & Gerbarg, 2012; Brown et al., 2013; Gerbarg, Wallace, & Brown, 2011).

The mechanisms by which yoga practices improve sympatho–vagal balance are being studied. Considerable evidence supports proposed bottom-up theories that yoga breathing and movement practices activate afferent interoceptive pathways via the vagal nerves (primary pathways of the parasympathetic system) and sympathetic pathways via the locus coeruleus (Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). By combining activating and calming techniques, both branches of the ANS can be strengthened and brought into better balance. Yoga and other mind–body practices that increase the ability of the higher centers (e.g., prefrontal cortex and insular cortex) to modulate the lower centers (e.g., amygdala), for example, by increasing release of gamma-aminobutyric acid (GABA), the brain’s primary inhibitory neurotransmitter, can reduce symptoms of anxiety and PTSD (Streeter et al., 2012).

Gard and colleagues (Gard, Noggle, Park, Vago, & Wilson, 2014) propose a systems-based network model that integrates top-down and bottom-up mechanisms of self-regulation. According to this model, specific yoga practices (ethics, postures, breath regulation, and meditation) affect self-regulation through bidirectional feedback loops that regulate cognition, emotions, behaviors, and peripheral physiology. In addition to the bottom-up mechanisms mentioned above, top-down mechanisms support conscious intention, motivation, executive monitoring, response inhibition, and reappraisal. This model assumes that changes occurring during yoga practice over time become more automatic and continue to operate in daily life. For example, maintaining yoga postures despite urges to move may improve inhibitory control and reduce impulsive maladaptive reactions outside of yoga practice.

Mindfulness-based interventions

Mindfulness meditation entails the intentional focusing of attention on awareness of the present moment, including physical sensations from external sensory events, interoceptions (awareness of internal bodily sensations), and internal mental events (cognitions and emotions) (Marchand, 2012). Modern psychotherapies, such as mindfulness-based interventions (MBIs), and hybrid programs such as Mindfulness-Based Cognitive Therapy (MBCT) and Mindfulness-Based Stress Reduction (MBSR), utilize many techniques derived from yoga, Buddhism, and qigong. For instance, ancient meditative forms of focusing or diffusing attention and awareness reappear in mindfulness meditation (MM). Mindful breathing (awareness of breath) and keeping attention on the present moment are additional examples. The nonjudgmental observation of thoughts, feelings, and bodily sensations, part of traditional yoga, is also an important technique in psychoanalysis, psychotherapy, and numerous developing therapies.

In reviewing the literature on MBIs, Edenfield and Saeed (Edenfield & Saeed, 2012) noted that although growing evidence may support the role of MBIs in depression-relapse prevention, little is known about their role in the treatment of acute symptoms of depression and anxiety. Less is known about the impact of specific components of MBIs, such as MM on the experience or expression of psychological distress. Although some studies report that MBSR, which combines mindfulness techniques with education about stress, coping strategies, and assertiveness, improved psychological functioning in patients with medical conditions, meta-analyses have found relatively small effects on anxiety (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010). Few studies have rigorously evaluated the dose–response relationship necessary for symptom improvement or the underlying mechanisms of change.

Studies of MBIs tend to attribute observed changes to cognitive components, for example, the intentional focus of attention on breathing rather than on the effects of the breathing itself (Feldman, Greeson, & Senville, 2010). However, it is possible that changes in breath rate (associated with focusing attention on the breath) are primarily responsible for neurophysiological changes (as noted above). The focus of attention on the breath may enhance or detract from the autonomic effects, depending on how effortful it is (Telles et al., 2013). Just as it is difficult to ascertain the thoughts of a subject in meditation, it is also difficult to quantify the mental effort that is being exerted during an attentional task. This complicates the interpretation and comparison of studies. In many studies, the breath rate is not measured, documented, or controlled. This shortcoming further limits the validity of attributing mechanisms or benefits to various aspects of these practices.

Evidence suggests that meditation and mindfulness may reduce emotional reactivity by modulating activity in the amygdala, cortical midline structures, anterior insula, and lateral prefrontal cortex (Marchand, 2012). One would expect reduction in emotional reactivity to work synergistically with improved abilities to attend to the present moment and reappraise perceived threats, contributing to better self-regulation of anxiety. Further research is needed to validate the connections between clinical changes in anxiety symptoms and proposed physiological mechanisms in mind–body studies.

Mindfulness and cognitive-behavioral therapy

Cognitive-behavioral therapy (CBT) addresses cognitive processes that contribute to symptomatology such as negative thinking, misappraisal, and so on. Some of the limitations of this predominantly intellectual (top-down) approach are being addressed by integrating cognitive approaches together with both meditative and body-centered modalities such as breath practices, movement, and meditation derived from yoga and qigong. For example, MBCT combines CBT with MBIs (Edenfield & Saeed, 2012). Some CBT practitioners incorporate breath awareness, breath practices, and movement into CBT. Some have gone so far as to say that movement and breathing are “behaviors” and, therefore, should be considered part of CBT. Other practitioners of CBT expand their techniques to include working with affect (emotion). Consequently, when we try to discuss specific practices such as movement or breathing, it is challenging to make distinctions between modalities. Evidently, different treatment modalities are adopting useful practices from one another such that the distinctions are becoming blurred. This is probably a positive development, because application of a broader array of techniques may better address patient differences and individual needs.

Voluntarily regulated breathing practices and autonomic regulation

Parasympathetic activation is more strongly affected by breath regulation than by sustained postures and meditation. Specific breathing techniques have been shown to increase PNS activity, reduce SNS overactivity, improve sympatho–vagal balance, and reduce cortisol release. In addition, these practices reduce perceived stress and negative psychological states (e.g., depression, anxiety, and PTSD) (Brown, et al., 2013; Lehrer et al., 2003; Streeter, et al., 2012). For most adults under 6 feet in height, breathing at 4.5 to 6.0 breaths per minute (bpm) (and for adults taller than 6 feet 3.0 to 4.5 bpm) induces optimal sympatho–vagal balance as indicated by measures of heart rate variability (HRV) (Brown and Gerbarg, 2012; Brown, et al., 2013). Evidence supports the concept that slow gentle breathing at 4.5–6 bpm for most adults increases activity of the PNS via afferent interoceptive pathways from respiratory receptor systems (e.g., mechanoreceptors, chemoreceptors, and baroreceptors). The vagal nerves and central autonomic pathways contain the main fibers of the PNS (Brown & Gerbarg, 2005). The PNS modulates the psycho-neuro-endocrine-immune systems, maintaining homeostasis through afferent tracts (to the hypothalamus, central ANS, limbic system, thalamus, and cortex) and efferent tracts (cholinergic anti-inflammatory pathways) to the organs and tissues of the body (Haroon, Raison, & Miller, 2012). Potential benefits of voluntarily regulated breathing practices (VRBPs), such as slow (4–6 bpm) Coherent Breathing and alternate nostril breathing, include improved psycho-neuro-endocrine-immune modulation, reduced perceived stress, and alleviation of negative psychological states (Brown & Gerbarg, 2005, 2012; Jacob et al., 2013; Joseph et al., 2005; Streeter et al., 2012; Telles, Sharma, & Balkrishna, 2014; Telles, Sharma, Yadav, Singh, & Balkrishna, 2014; Zhang et al., 2009).

Fundamentally, anxiety is a condition in which an individual feels unsafe. Insecure attachment, emotional dysregulation, disconnection, and isolation underlie anxiety disorders. Disconnection from the body is a survival mechanism for victims of abuse. In extreme PTSD cases, abuse survivors may have no sense of inhabiting their own bodies and experience significant dissociation. Some experience terror or noxious physical sensations when they are touched or when feelings occur in parts of their bodies. Slow, gentle yoga postures (asanas) with an experienced teacher can augment psychotherapy by gradually enabling individuals to tolerate physical and sensory experiences and to discover ways to inhabit their bodies in a safe, supportive environment (van der Kolk et al., 2014).

Anxiety can also impair the ability to trust and to form close loving relationships. Practices that increase PNS activity and HRV support social engagement systems (Porges, 2009). Furthermore, vagal nerve–stimulation studies and preliminary clinical evidence suggest that yoga programs, and in particular slow breath practices, may increase the release of oxytocin, the prosocial bonding hormone (Jayaram et al., 2013). The use of yoga in psychotherapy to enhance trust, bonding, and reconnection with the self and with others is worthy of exploration (Gerbarg & Brown, 2014; Gerbarg, Gootjes, & Brown, 2014).

Meditative movement

Meditative movement differs from conventional exercise in its inclusion of a meditative state of mind, focusing attention and awareness on the breath and on the body with deep relaxation (Larkey, Jahnke, Etnier, & Gonzalez, 2009). Payne and Crane-Godreau (Payne & Crane-Godreau, 2013) consider the focus of awareness on spatial, interoceptive, proprioceptive, and kinesthetic sensations to be the defining characteristic of meditative movement. Plausible mechanisms for the effects of meditative movement on anxiety and other affective states have been proposed, including postures and grounding; interoception and proprioception via afferent vagal pathways; coordination by basal ganglia of affective, interoceptive, attentional, executive, association, memory, and sensorimotor circuits; changes in brain default mode; imagery; and long-term neuroplastic changes with practice (Payne & Crane-Godreau, 2013).

Grounding practices

Grounding practices enhance the sense of being solidly connected to the ground. This can ameliorate anxiety by increasing feelings of balance and stability. Individuals with PTSD, who are subject to dissociation, can benefit from grounding practices as an aid to staying in the present reality rather than disconnecting, dissociating, regressing, or getting caught in re-experiencing the past, as in a flashback. The use of grounding in treatment of dissociative disorders is an area that warrants research (Benham, 1995; Hien, Cohen, Miele, Litt, & Capstick, 2004; Najavits, 2002; Najavits, Gallop, & Weiss, 2006). Physical movements generate proprioceptive and kinesthetic sensations. Focusing attention on these sensations can enhance interoception, alter neuronal connections between the anterior and posterior insula, and possibly ameliorate anxiety (Farb, Segal, & Anderson, 2013). Meditative states associated with movement or breathing may shift brain activity from anxious rumination (default mode network activity) toward increased attention to present-state interoceptions (Payne & Crane-Godreau, 2013).

Top-down and bottom-up approaches for anxiety

Anxiety entails misappraisals, cognitive malfunctions, impaired integration, and failure of higher brain centers to modulate overreactivity of lower centers and stress-response systems. The fundamental misappraisal is the perception of danger far in excess of the present reality, even when the individual may know intellectually that there is no real danger. In such cases, when verbal reassurance and other cognitive approaches are ineffective, bottom-up methods, by circumventing the intellect and activating interoceptive pathways to both higher and lower centers, can resolve the anxiety and restore impaired cognitive functions (Gerbarg, 2008; Gerbarg et al., 2014).

Review of published research

Previous reviews of research on yoga and anxiety disorders

Several reviews of studies of yoga for anxiety have been published. Of these, the first formed part of a broad review of complementary and self-help treatment, and only two yoga trials were identified (Jorm et al., 2004). The absence of well-conducted studies led the authors to conclude that it was impossible to assess the effectiveness of yoga for anxiety disorders. A more focused and comprehensive systematic review located eight trials of yoga in a range of anxiety disorders (Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005). Again, due to variations in these studies and methodological limitations, firm conclusions as to the efficacy of yoga could not be reached. Of the reviews published subsequently, one was narrative rather than systematic (Joshi & De Sousa, 2012) and one included a range of study types but no formal quality assessment (Li & Goldsmith, 2012). Other reviews discussed the evidence only briefly because the aim was to address a range of complementary therapies (Sarris et al., 2012) or to examine the effectiveness of yoga for various psychiatric disorders (Cabral, Meyer, & Ames, 2011; Chugh-Gupta, Baldassarre, & Vrkljan, 2013). Several of these reviews did, however, conclude that a potential role for yoga in the management of these disorders is a valuable focus for research.

A more systematic approach was taken in one review, with the evidence rated for yoga on each anxiety disorder (da Silva, Ravindran, & Ravindran, 2009). This review concluded that there was preliminary Level 2 evidence (based on at least one randomized controlled trial (RCT)) for yoga as monotherapy or in addition to medication for OCD, more extensive Level 2 evidence as a second-line monotherapy for test or performance anxiety, and Level 3 evidence (based on uncontrolled studies) for yoga as monotherapy or in addition to medication for PTSD. The following review of research revisits and extends the systematic review on this topic originally published in 2005 (Kirkwood et al., 2005). Clinical trials, randomized and nonrandomized, with or without a control group, were identified through searches of major databases including AMED, Cochrane, Medline/PubMed, and PsycINFO using a detailed search strategy. Trials are presented according to the specific anxiety disorder: GAD, OCD, panic disorder, phobia, and PTSD. Trials were assessed on overall design, randomization, baseline comparison of groups, and attrition.

Generalized anxiety disorder (GAD)

Anxiety is often included as an outcome measure in studies of yoga, for example, trials in people with cancer or chronic illness. There has also been a series of studies of yoga in anxiety related to performing a specific task (e.g., music performance) (Khalsa, Butzer, Shorter, Reinhardt, & Cope, 2013; Khalsa & Cope, 2006; Khalsa, Shorter, Cope, Wyshak, & Sklar, 2009). These have indicated potential beneficial effects of yoga in relief of anxiety, but there have been a limited number of yoga studies specifically on people with chronic, excessive anxiety such as in GAD. A previous systematic review found several studies in *anxiety neurosis* , a diagnosis that has now been superseded by the diagnosis of GAD (Kirkwood et al., 2005). These studies included one based in an Indian hospital in which participants were assigned to yoga or a placebo capsule (Sharma, Azmi, & Settiwar, 1991). Yoga, consisting of a week's training in *kapalabhati* (Breath of Fire) and *ujjayi* (victory over the mind through the breath) pranayama, followed by twice daily practice, was reported to be more effective at reducing anxiety scores than the placebo, and the size of these changes was clinically significant. However, this was not an RCT. This factor combined with the lack of blinding inherent in yoga trials is likely to have an impact: patient-reported outcomes may be influenced by the expectation of an effect. High attrition rates (more than 30%) were also observed in both yoga and control groups. A similar study from India compared yoga to treatment with an anxiolytic drug (diazepam) (Sahasi, Mohan, & Kacker, 1989). A combination of training and home practice was employed: 5 days a week were instructed and 2 days were for home practice. The yoga intervention consisted of *sukhasana* (tailor seat or easy posture), mountain pose, pranayama (control of breath or vital energy)*, nishpandbhav* (unmoving observation) and corpse pose. The randomization process was, however, not adequate and, although a within-group change was reported as significant in the yoga group, post hoc testing revealed that the overall difference between groups after 3 months was not statistically significant.

Two further Indian studies focused on *psychoneurosis* , a diagnosis that usually reflects anxiety combined with symptoms of depression rather than GAD per se (Vahia et al., 1973a; 1973b). The first study is particularly interesting in that a "pseudo-yoga" treatment was used in which participants were instructed to relax, carry out sham postures and breath control, and write thoughts in a way that resembled the genuine yoga (Vahia et al., 1973a). Baseline anxiety was equivalent in the yoga and control groups but then reduced in the genuine yoga group. The results are difficult to interpret, because the degree of similarity between the two treatments is unclear. The second study used a combination of anxiolytic and antidepressant therapy for comparison with yoga, and again a greater reduction in anxiety was seen in the yoga group. In this study, the participants had mixed diagnoses, including psychoneurosis and psychosomatic disorder such that the implications for GAD are unclear. Due to the limitations described above, the systematic review concluded that “owing to the diversity of conditions treated and poor quality of most of the studies, it is not possible to say that yoga is effective in treating anxiety or anxiety disorders in general” (Kirkwood et al., 2005).

Relatively small studies have been conducted with yoga either as an adjunct or as an alternative to standard treatment for GAD. Those that have been published in full are presented in Table 6.1 (p. 105). Of those investigating the potential of yoga as an adjunct, one study measured the effects of Sudarshan Kriya Yoga (SKY) in patients with a primary diagnosis of GAD (Katzman et al., 2012). Another study explored the potential value of enriching CBT with Kundalini Yoga (Khalsa, Greiner-Ferris, Hofmann, & Khalsa, 2015). Neither of the studies was randomized or controlled, and a significant number of participants did not complete the program being tested. Nevertheless, both studies did provide promising findings in terms of significant pre–post changes in a number of measures. In the second study, the participants had previously proved treatment-resistant, suggesting that further investigation in this challenging population would be worthwhile. A further small pilot study compared yoga with naturopathy in 12 patients (Gupta & Mamidi, 2013). After 3 weeks’ treatment, both groups of patients had improved levels of anxiety, but no difference in effectiveness was found between groups. Due to the small size of the study, the lack of an observed difference may simply have been caused by a lack of power to detect a difference, and these findings can be described as preliminary at best.

The final two studies are both RCTs (Dermyer, 2009; Ranjbar, Hemmati, & Rezaei, 2011). Participants had received a diagnosis of GAD from a health professional, and 33 and 40 participants were recruited respectively. In the first study, the control group was assigned to watch movies, and a waitlist control was used in the second study. The yoga intervention differed: one was based on hatha yoga (Ranjbar et al., 2011) while the second study involved a specific program, the Fu-ZEN D 2 Yoga-Stretch Program, a modified form of hatha yoga (Dermyer, 2009). Both trials reported significant differences between groups after the study period, but neither study has been published in full in a peer-reviewed journal. Consequently, it is not possible to carry out an adequate appraisal of the methods, and the findings must therefore be considered preliminary.

Obsessive-compulsive disorder

The use of yoga for managing OCD has been investigated in two studies by one research group in the United States. An initial report in 1996 described an uncontrolled pilot study of eight people (Shannahoff-Khalsa & Beckett, 1996). The intervention focused on yoga-based breathing techniques, and improvements in symptoms of OCD were noted between baseline and 12 months. The lack of a control group means that it is impossible to confirm whether the improvements were due to yoga. The study did, however, demonstrate feasibility of these techniques for this patient group.

The subsequent RCT by the same group compared Kundalini Yoga meditation with relaxation response plus mindfulness meditation (Shannahoff-Khalsa et al., 1999). Greater improvements on the Yale-Brown Obsessive Compulsive Scale (Y-BOCS), a validated scale for this disorder, were noted in the yoga group compared with the control group. In this study, there was an attempt to blind patients to the treatment protocol and the groups were well matched at baseline. Several patients in each group failed to complete the programs, but the difference between groups was maintained even after intention-to-treat analysis. These findings were considered suggestive of a potential role for yoga in the management of OCD.

Nevertheless, except for publication of a case study revealing a patient's perspective on this approach (Shannahoff-Khalsa, 2003), there appears to have been limited subsequent research interest in this area. One further study has, however, been published and was conducted in Iran (Ranjbar et al., 2011). In contrast to the previous studies, the yoga intervention in this trial was hatha yoga twice a week for 6 weeks under the supervision of trained instructors. The same outcome measure was used as in the previous studies (Y-BOCS). Forty women aged between 19 and 55 either practiced yoga or watched TV. Anxiety levels were reduced in both groups but there was no significant difference between groups, leading to the conclusion that yoga did not appear to be effective. The lack of effect may be due to the relatively short duration of the yoga intervention. It is also possible that, because the trial was small, it may have been underpowered to detect a difference between the two groups. A summary of the studies in OCD is presented in Table 6.2 (p. 106).

Panic disorder and phobia

Symptoms of panic were recorded in a trial in people with GAD (Khalsa et al., 2015), but there have been no studies specifically on this disorder. The only other report is a single case of yoga therapy, provided on an individual basis, in the successful treatment of anxiety and panic disorder in an adolescent female (Williams-Orlando, 2013).

The influence of yoga practice on phobia has also received little attention. Only one study, on snake phobia, has been published (Norton & Johnson, 1983). Agni yoga and modified progressive-relaxation training were tested in 40 moderately snake-phobic people. The participants were first categorized as either “somatically-anxious” or “cognitively-anxious” on the basis of a questionnaire. Half of the subjects in each group received the relaxation training and half received Agni yoga training for four sessions. The assessment of effectiveness was based on measures taken in association with a snake-approach test. Approach distance, subjective fear, and pulse rates were measured during the test, and a snake fear scale was completed pre- and post-test. Differential effects within groups and interventions were seen, with some support for the hypothesis that yoga may be more appropriate for cognitive rather than somatic anxiety. These studies are summarized in Table 6.3 (p. 106).

Posttraumatic stress disorder

The main focus of research on yoga in anxiety disorders has been on PTSD. Completed studies can be categorized as those on the general population diagnosed with PTSD, those on military personnel post active service, and those on populations who have experienced a natural disaster. These studies are presented in Table 6.4 (p. 107).

Studies in people from the general population diagnosed with PTSD

Examples of this category include two small pilot studies, one uncontrolled and one in which yoga was compared with group therapy based on dialectical behavior therapy (DBT) (van der Kolk, 2006). The findings suggested that simple hatha yoga exercises may be helpful in reducing intrusions (intrusive thoughts or “flashbacks”) and hyperarousal symptoms in women with PTSD.

Subsequently, there have been efforts to develop yoga protocols that are adapted for use with individuals who have PTSD. One study compared such an intervention, a “trauma-sensitive” yoga protocol, with typical group psychotherapy (Clark et al., 2014). This study was primarily a feasibility study for a larger RCT, the main aim being to assess recruitment and retention rates and participants’ perceptions of safety and utility of the study. Another pilot study compared Kripalu-based (hatha) yoga with an assessment control (Mitchell et al., 2014). The participants were all women but, in this case, both women veterans and civilians with full or subthreshold PTSD were included. The yoga and control groups improved clinically but between-group differences were small to moderate, possibly due to the high attrition rate, with only 26 of 38 completing the study.

A full RCT was completed involving 64 women with chronic treatment-resistant PTSD (van der Kolk et al., 2014). The intervention, described as a “trauma-informed” yoga class, was compared with a supportive women’s health-education class. The women attended 1-hour classes on a weekly basis for 10 weeks. Both groups of women improved over the treatment period, but there was a significant difference in the number of women who no longer met the criteria for PTSD at the end of the study (52% in the yoga group and 21% in the control group, $p = .013$). The effect size for yoga was reported to be comparable to that of established psychotherapeutic and pharmacologic approaches, suggesting that this may be an area for future research.

Studies in military personnel post active service

Beneficial effects of twice weekly yoga were reported in an uncontrolled pilot study of 12 veterans with military-related PTSD (Staples, Hamilton, & Uddo, 2013). Positive results have also been reported in more rigorous RCTs. One such study recruited 70 personnel deployed to a war zone, half of whom were randomly allocated to 3 weeks of "sensory-enhanced" yoga (Stoller, Greuel, Cimini, Fowler, & Koomar, 2012). Two smaller trials used a SKY-based intervention (Carter et al., 2013; Seppala et al., 2014). The subjects in the first trial were Australian military veterans who were classified as 100% disabled due to chronic treatment-resistant PTSD (Carter et al., 2013). SKY was reported to have been adapted for veterans by removing religious content, adding joint mobility exercises, and addressing warrior values. In the second SKY study, which treated US military veterans, no such adaptation was mentioned (Seppala et al., 2014). In all three trials, the control group received no comparable intervention. This means that changes cannot be conclusively proven to be due to yoga, but yoga practice did result in positive outcomes with significantly improved state and trait anxiety (Stoller et al., 2012), improvements in PTSD scores (Carter et al., 2013), and improvements in both anxiety symptoms and PTSD scores (Seppala et al., 2014) compared with control.

Studies in populations who have experienced a natural disaster

The third group of studies differ from the previous studies primarily in their setting. These studies have explored whether yoga offers any beneficial effects for individuals in the aftermath of a natural disaster. Those recruited have recently experienced a life-altering tsunami or earthquake. The earliest of these studies was based in the Andaman Islands in the Bay of Bengal (Telles, Naveen, & Dash, 2007). A Vivekananda yoga program was introduced to a group of indigenous people and settlers. Self-reported subjective outcomes improved, as did breathing rates. Because there was no conventional control group and the main outcomes did not include a validated PTSD scale, the results are indicative only. Similar results were recorded in a small RCT in flood survivors in India (Telles, Singh, Joshi, & Balkrishna, 2010). In this trial, however, many of the potential sample population were excluded due to diagnosed illness or to imminent transfer from the area. Tsunami survivors in India were also the target population for a larger ($N = 183$) controlled trial (Descilo et al., 2010). This compared a yoga-based breathing technique with or without a trauma-reduction technique against a waitlist control group. Due to sensitivity to the situation in the refugee camps where the study took place, allocation was based on camp location and not randomization. However, the refugees came from similar fishing villages, the camps were comparable, and there were no significant differences in the mean baseline measures among the three study groups. Furthermore, a standardized outcome measure was used and a significant effect of the yoga interventions was recorded.

The most recent study in this group took place in Iceland and focused on local inhabitants who had recently experienced an earthquake (Thordardottir, Gudmundsdottir, Zoega, Valdimarsdottir, & Gudmundsdottir, 2014). A similar design to several previous trials was used, in that one group was assigned to a yoga program and the other group to a waitlist control group. In this case, differences between groups after the intervention were not significant. It is challenging to interpret these results because allocation into study or control group was based on location rather than randomization, outcomes are self-reported, and numbers in each group were small.

Insights from qualitative research

In an attempt to understand the experiences of yoga when suffering from stress-related illness, participants in a trial of yoga were interviewed (Anderzen-Carlsson, Persson Lundholm, Kohn, & Westerdahl, 2014). Phenomenological analysis of the interviews revealed that yoga was not seen as an endpoint of recovery but the start of a process towards an "increased sense of wholeness" (p. 3). Yoga served as a tool for dealing with stress. Using the body in a new way, as required with yoga postures, improved self-esteem and led participants to a different perception of themselves and their lives. Another interview-based study indicated that Integrative Restoration (iRest) *yoga nidra,* a form of body-based mindfulness meditation, helped in reducing negative emotions and increased positive feelings despite persistent problems, including intrusive memories (Stankovic, 2011). Exploratory qualitative studies such as this, that improve understanding of yoga practice, are limited in number, suggesting a potential research gap.

Summary

To date, only a limited number of studies have been completed on yoga for specific anxiety disorders. Yoga researchers have faced challenges in designing rigorous studies for testing complex interventions for which there is no universally agreed adequate comparison intervention. Challenges related to assessing complex interventions such as yoga have begun to be addressed with initiatives, such as the CONSORT (CONsolidated Standards for Reporting Trials) extension for reporting trials of nonpharmacological treatment interventions (Boutron et al., 2008) and the development of Cochrane reviews of complex interventions. The yoga interventions are themselves extremely varied, and trials are often conducted in unique environments or contexts with small groups of essentially self-selected participants. An added challenge in anxiety studies is the reliance on self-reported measures of outcomes. Some studies use limited physiological measures, such as pulse rate, but additional objective measures of anxiety states could be applied. Consequently, the current status is that the studies that have been completed provide promising but, as yet, inconclusive findings that warrant further exploration and assessment. The fact that benefits have been achieved in conditions and populations for which there are limited effective conventional treatments is, however, worth consideration.

Future directions

Although there are many positive studies of yoga for anxiety, most are of poor quality and cannot yield definitive conclusions. Better methodologies are being used in more recent studies, but due to the limited availability of research funding, the majority of these have small numbers of subjects. Larger, long-term, RCTs are needed to validate and extend the findings from the older and less rigorous research. Another challenge in yoga research is the need for clear, detailed descriptions of the practices. In addition, the subjects in many studies do not have clear, clinically defined diagnoses of anxiety disorders. Yoga protocols often combine large numbers of movement, breathing, and meditative practices that make it difficult to sort out which techniques or combinations of techniques are primarily responsible for the observed changes in anxiety. This heterogeneity makes it difficult to compare findings or to assess the evidence base.

Yoga studies using advanced technologies, such as brain imaging, are beginning to reveal anatomic, neuroplastic, and neurotransmitter changes in response to the mind–body practices of yoga. These discoveries will undoubtedly augment current understanding of mechanisms of action. However, such studies are expensive and are limited to researchers with access to the specialized equipment and the large grants needed to support them. Clinical trials using psychological measures, physiological markers, and a wide variety of mind–body techniques will continue to explore many fruitful treatment areas ranging from everyday stress to PTSD.

Possible goals for future research include understanding the neurophysiological mechanisms for the effects of a wider range of individual and combined practices on affective states. By identifying the effects of individual components within complex practices, it may be possible to create more effective and efficient programs that target specific symptoms, such as anxiety, and to adapt practices to the needs of different populations and treatment settings. Including the widest possible range of mind–body practices, such as traditional yoga, qigong, tai chi, martial arts, paced breathing, and technology-assisted practices, would provide a larger pool of better quality studies to analyze, compare, identify common elements, and create novel treatments.

Table 6.1 Studies of yoga in generalized anxiety disorder (GAD)				
Study	**Participants**	**Intervention**	**Outcome measures and outcomes**	**Research design**
Gupta and & Mamidi, 2013	12 patients with GAD (DSM-IV-TR)	Yoga asanas and pranayama (some individual variation) 1 hour daily (6) compared with naturopathy (6) for 3 weeks	HAM-A: significant improvements within groups (p <.001) but not between groups (p >.05). No significant adverse effects	Pilot RCT. Randomization not adequate. No baseline comparison. No drop-outs reported
Katzman et al., 2012	41 outpatients with a primary diagnosis of GAD (DSM-IV-TR) with or without comorbidities	SKY 22 hours over 5 days as adjunct to standard treatment	HAM-A: significant reduction in scores after 4 weeks (p <.01).Range of other outcome measures used	Open-label trial. No control group. 31 completed course. ITT analysis using LOCF
Khalsa, Greiner-Ferris, Hofmann, & Khalsa, 2015	32 treatment-resistant clients with GAD and comorbid diagnoses at a community mental health clinic	Yoga-enhanced CBT (CBT plus kundalini yoga), 6 weekly 90-minute sessions	STAI: significant improvements in state and trait anxiety (p = .001) TOP: depression, panic, sleep, quality of life significantly improved. No adverse effects reported	Pilot study. No control group. 22 completed program. Non-completers similar to completers but with higher scores on TOP violence subscale

CBT: cognitive behavioral therapy; DSM: *Diagnostic and Statistical Manual* ; HAM-A Hamilton Anxiety Rating Scale; ITT: intention-to-treat; LOCF: last observation carried forward; RCT: randomized controlled trial; SKY: Sudarshan Kriya Yoga; STAI: State Trait Anxiety Inventory; TOP: Treatment Outcome Package.

Table 6.2 Studies of yoga in obsessive-compulsive disorder (OCD)				
Study	**Participants**	**Interventions**	**Outcome measures and outcomes**	**Research design**
Ranjbar, Hemmati, & Rezaei, 2013	40 women with OCD diagnosed by a psychiatrist based on DSM-IV-TR	Hatha yoga twice weekly for 6 weeks versus watching television	Y-BOCS improved in both groups but no significant difference between groups; decrease in anxiety only significant in yoga group ($p < .05$). BAI score also improved. No mention of adverse effects	RCT. No details of randomization. Groups matched at baseline. Assessors were blinded. No mention of attrition
Shannahoff-Khalsa & Beckett, 1996	8 adults with OCD	Specific yogic breathing pattern for 1 year	Y-BOCS: significant improvement ($p \leq .046$); SC-90-R OC, Anxiety and GSI, and PSS scores also significantly improved	Uncontrolled study. 5 completed course
Shannahoff-Khalsa et al., 1999	21 adults and 1 adolescent with DSM III-diagnosed OCD	Kundalini yoga meditation protocol (11) versus relaxation response plus mindfulness meditation technique (10) 60 minutes daily for 3 months	Y-BOCS, SCL-90-R OC and GSI, and POMS: greater improvements in yoga group ($p < .003$), nonsignificant improvements on PSS and PIL. No apparent adverse effects	RCT. Randomization adequate. Patients blinded to treatment protocol. 7 per group completed ITT analysis

BAI: Beck Anxiety Inventory; DSM: Diagnostics and Statistical Manual; GSI: Global Severity Index; ITT: intention-to-treat; PIL: Purpose in Life test; POMS: Profile of Mood States; PSS: Perceived Stress Scale; SC: symptoms checklist; RCT: randomized controlled trial; Y-BOCS: Yale-Brown Obsessive-Compulsive Scale.

Table 6.3 Studies of yoga in panic and phobia				
Study	**Participants**	**Interventions**	**Outcome measures and outcomes**	**Research design**
Khalsa, Greiner-Ferris, Hofmann, & Khalsa, 2015	32 treatment-resistant clients with GAD and comorbid diagnoses at a community mental health clinic	Yoga-enhanced CBT (CBT plus kundalini yoga), 6 weekly 90-minute sessions	TOP panic subscale: significant improvement (0.0008). See Table 6.1 (p. 105) for other outcomes	See Table 6.1
Norton & Johnson, 1983	40 moderately-to-very fearful snake-phobic psychology students screened using SNAQ	Agni yoga (slightly modified) for 4 sessions of 45 minutes plus home practice over 3 weeks compared with progressive relaxation	BAT score – no significant main effects. Results are focused mainly on type of anxiety (somatic or cognitive)	RCT. Randomization not described. Baseline comparison not reported. Attrition rate unclear

BAT: Behavioral Approach Test; CBT: cognitive behavioral therapy; GAD: generalized anxiety disorder; RCT: randomized controlled trial; SNAQ: Snake Attitude Questionnaire; TOP: Treatment Outcome Package.

Table 6.4 Studies of yoga in posttraumatic stress disorder (PTSD)				
Study	**Participants**	**Interventions**	**Outcome measures and outcomes**	**Research design**
Carter et al., 2013	31 male military veterans with PTSD (DSM-IV)	SKY (adapted for veterans) 22 hours over 5 days with follow-up sessions and home practice (n = 16) or a 6-week waitlist control (n = 15)	CAPS: significant decrease in scores in yoga but not control group ($p < .01$). Also assessed PCL-17, WHO QOL, and other outcomes. Exacerbation of respiratory symptoms in 2 participants	RCT. Randomization appeared adequate. Assessors were blinded. 25 completed the study. LOCF used
Clark et al., 2014	17 adult female clients seeking group psychotherapy after a domestic abuse program	A 12-week trauma-sensitive yoga protocol for 30–40 minutes once weekly at the end of each group therapy session (n = 8). Control: typical group psychotherapy (n = 9)	Focus on feasibility not outcomes No reported emotional or physical harm	RCT feasibility study. Availability sampling used for group allocation. Baseline comparability not reported. Loss to follow-up 30%
Descilo et al., 2010	183 tsunami survivors from southeast India scoring 50+ on the PCL-17	Yoga breath intervention (ujjayi, bhastrika, chanting om, and SKY) daily for 2 hours for 4 days (n = 60), yoga plus trauma-reduction exposure technique (n = 60) or 6-week waitlist (n = 63)	PCL-17: effect of treatment versus control was significant at 6 weeks ($p <$ .001). Also significant effects on BDI and GHQ-12 No adverse effects reported	Nonrandomized controlled trial (allocation based on refugee camp). Groups were comparable demographically and symptomatically at baseline. Attrition 23%, similar in all groups

Mitchell et al., 2014	38 veteran and civilian women with PTSD symptoms diagnosed by PSS-I	Twelve 75-minute sessions Kripalu-based hatha yoga intervention weekly or twice weekly (*n* = 20) with an assessment control group (*n* = 18)	PCL-Civilian (PCL-C) clinically significant decrease in both groups. Between-groups effect sizes were small to moderate (0.08–0.31)	RCT pilot study. Randomization appeared adequate. Groups comparable at baseline. 26 completed the study
Seppala et al., 2014	21 US male military veterans	Breathing-based meditation (SKY) 21 hours over 7 days (*n* = 11) or waitlist control (*n* = 10)	Reductions in PCL-Military scores (p = .007), anxiety symptoms, and respiration rate in yoga group but not control group. No adverse effects reported	RCT. Randomization appeared adequate. Groups were comparable. 18 completed the study ITT analysis
Staples, Hamilton, & Uddo, 2013	12 male and female veterans with military-related PTSD	Yoga intervention 1 hour twice a week for 6 weeks	PCL – Military version (PCL-M), PSQI, STAXI-2: significant improvement in hyperarousal symptoms, sleep quality and daytime dysfunction (p < .05). No adverse effects reported	Pilot study, uncontrolled. No attrition
Stoller, Greuel, Cimini, Fowler, & Koomar, 2012	70 male and female military personnel who were deployed to a warzone	Sensory-enhanced hatha yoga, minimum of nine 75-minute sessions over 3 weeks (*n* = 35), and 35	AASP, STAI and QOL Survey: significant reduction in state and trait anxiety based on STAI scores	RCT Randomization appeared to be adequate, groups differed on sensory sensitivity. Initial sample size not

		did not receive any form of yoga	compared with no yoga ($p < .001$)	achieved but attrition low. ITT analysis
Telles, Naveen, & Dash, 2007	47 tsunami survivors in the Andaman Islands in the Bay of Bengal	Vivekananda yoga program (asanas, pranayama, yoga-based guided relaxation) 60 minutes daily for 8 days	Significant decrease in self-rated fear, anxiety, sadness, and disturbed sleep, and breath rate in both groups ($p < .05$) No between-group comparison or report on adverse effects	Uncontrolled study. Two comparison groups (settlers and indigenous people). Attrition not reported
Telles, Singh, Joshi, & Balkrishna, 2010	22 male flood survivors from Bihar in north India screened with SQD	Yoga for 1 hour daily (similar to Telles, 2007) ($n = 11$) versus routine activities ($n = 11$)	Emotional distress symptoms using VAS: sadness decreased in yoga group, anxiety increased in nonyoga group ($p < .05$). No adverse effects reported	RCT. Randomization and allocation concealment appear adequate. Groups well matched. No loss to follow-up
Thordardottir, Gudmundsdottir, Zoega, Valdimarsdottir, & Gudmundsdottir et al., 2014	66 male and female inhabitants from two villages in South Iceland after an earthquake	Hatha yoga program 60 minutes twice a week for 6 weeks ($n = 31$), waitlist control group ($n = 35$)	PDS plus four other measures: significant improvements in stress and some stress-related symptoms, differences between groups not significant	Non-randomized controlled trial (groups based on residential area but otherwise comparable at baseline). 58 completed the study
van der Kolk, 2006	11 participants	Hatha yoga: 8 sessions	CAPS: total pre–post yoga ($p \leq .01$). No	Pilot study. Limited details available

			mention of adverse effects	
van der Kolk, 2006	8 female patients with PTSD	Simple hatha yoga exercises for 75 minutes compared with 8 sessions of DBT-based group therapy	Davidson PTSD Scale, PANAS, TCBAS: significant decreases in intrusions and hyperarousal symptoms in yoga group only ($p < .05$). No mention of adverse effects	RCT. Randomization not described. Limited details available
van der Kolk et al., 2014	64 women with chronic, treatment-resistant PTSD	Trauma-informed hatha yoga or supportive women's health education, each as a weekly 1-hour class for 10 weeks	CAPS: significant decreases in PTSD symptoms in both groups initially ($p = .001$), improvements maintained in yoga but not control group	RCT. Randomization not described. Groups comparable at baseline except for employment. 60 completed the study. ITT analysis

AASP: Adolescent/Adult Sensory Profile; BDI: Beck Depression Inventory; CAPS: clinician administered PTSD scale; COPD: chronic obstructive pulmonary disease; DBT: dialectical behavior therapy; DSM: *Diagnostic and Statistical Manual* ; GHQ: General Health Questionnaire; ITT: intention-to-treat; LOCF: last observation carried forward; PANAS: Positive and Negative Affect Scale; PCL: Posttraumatic Checklist; PDS: Posttraumatic Stress Diagnostic Scale; PSQI: Pittsburgh Sleep Quality Index; PSS-I: PTSD Symptom Scale-Interview; QOL: Quality of Life; SKY: Sudarshan Kriya Yoga; RCT: randomized controlled trial; SQD: Screening Questionnaire for Disaster; STAI: State Trait Anxiety Inventory; STAXI: State and Trait Anger subscale; TCBAS: Trauma Center Body Awareness Scale; VAS: visual analog scale.

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ANXIETY: CLINICAL INSIGHTS

TIMOTHY MC CALL IN COLLABORATION WITH THE CONSULTING YOGA TEACHERS AND YOGA THERAPISTS

From the yogic viewpoint, perhaps the most obvious imbalance in people with anxiety spectrum disorders is in the breath: “shallow, rapid, or gasping breathing,” is common, observes Leigh Blashki. From an ayurvedic perspective, he says, people with anxiety spectrum disorders commonly manifest signs and symptoms of increased *vatadosha* . “For some, movements are fast and continual (hyperkinetic), while for others there is minimal physical movement, bordering on catatonia (these folks internalize their anxiety more).”

”Paramount in working with generalized anxiety disorders,” Blashki says, “is the teaching of what in yoga we call ‘belly breathing,’ along with gradually extending the length of the exhalation in relation to the length of the inhalation. This type of breathing helps reduce arousal,” shifting people from sympathetic to parasympathetic dominance of the autonomic nervous system (ANS).

According to Rolf Sovik, “Panic disorder appears to have a variety of interlinked causes. Among them, disordered breathing plays an important role in both the production and maintenance of symptoms. Diaphragmatic breath training helps in gaining psychological distance from symptoms and in reducing the intensity of symptoms caused by hyperventilation. It also offers sufferers a sense of self-control. Yogic breath training is thus a helpful adjunct to psychotherapy."

Amy Weintraub finds that many anxious students become too self-conscious if they attempt to improve their breathing technique. She has modified a traditional three-part yogic breath into what she calls "stair-step breath" (see Chapter 5 , pp. 91–93), using metaphorical rather than technical language to address this problem. Sovik says, "Focusing excessively on the physiological details of breathing can be counterproductive, with students left worrying that they aren't 'doing it right.' It is far more important to call attention to the pleasant sensations of good breathing than to struggle conceptually over its mechanics. Once the sensations of good breathing are internalized, confidence can begin to be restored."

Blashki says, "An approach that I use for many of these students is to teach them how to 'welcome' their anxiety symptoms as messengers and to recognize them as changing sensations and perceptions, but that there is an unchanging, whole Self behind it all." This reframing strategy reflects the yogic notion that unpleasant emotions sometimes herald a deeper problem that warrants exploration, and that premature efforts to relieve the symptoms can sometimes backfire, because the root cause remains unaddressed. In addition is the idea that even in an anxious state, beneath the thoughts, emotions, and sensations lies a well of calm that yoga can help us to access.

Although practices that foster relaxation can be helpful for those with anxiety, Amy Weintraub cautions, "In my observation, when you support someone with high levels of anxiety in a restorative or calming practice too quickly, you risk increasing their agitation.” Blashki finds that “depending on the individual, flowing vinyasa-style asanas can be helpful to better ‘contain’ hyperkinetic and obsessive-thinking tendencies.” Judith Hanson Lasater notes, however, that “just doing super-active *asana* without plenty of time to do more restorative practices can also be a mistake. Using a more-active practice early in a yoga session can allow the student to later settle into calming and grounding practices, and is often a more effective way to lower levels of anxiety.”

Abhijit Redij finds that in people with anxiety it is crucial “to keep the mind always engaged while performing yoga, be it breathing techniques or physical postures.” Performing relaxation techniques and breathing practices without the teacher’s ongoing guidance, he believes, risks an onslaught of thoughts troubling the individual. So rather than simply placing a student in *savasana* (corpse pose) and then staying silent, the teacher will gently provide instructions guiding students throughout the practice. In addition to guided *savasana* (corpse pose), he has had good luck with chanting, specifically having students repeatedly sound the mantra *om* .

Richard Miller has had success using *yoga nidra,* a guided body-based meditation technique typically done with the student lying in savasana, in helping students with posttraumatic stress disorder (PTSD) and other disorders associated with anxiety. Miller says that systematically sensing different areas of the body facilitates deep relaxation, especially when the student “is taught to (1) soften the jaw, (2) soften the ears, (3) soften the eyes, (4) soften the shoulders, and (5) sense the palms.” This process quiets the mind, he finds, as students shift from thinking to feeling and experiencing bodily sensations.

Miller says, “I’ve heard medical and health care practitioners say that meditation and *yoga nidra* are contraindicated for folks with PTSD, depression, and other anxiety disorders. This has not been my experience working with thousands of veterans and folks with these issues.” He worries that such statements may scare people away from practices that can be extremely helpful to them.

In creating images for guided meditations, Weintrab finds, “It’s always more empowering for clients if they can generate a soothing image from their memory or imagination than if given one by the yoga therapist.” For students who are not visual thinkers or when instructing a group, she recommends saying: “If an image doesn’t readily arise, you might simply think the word ‘peace,’ for example.”

Shanti Shanti Kaur Khalsa finds that yogic breathing techniques can be crucial in dealing with the dysfunction of the ANS that accompanies PTSD. She also uses *kriyas* (sequences of practices) and meditations designed for trauma recovery. In addition, she says, the practice of *svadhyaya* (self-observation) is consistently woven into the curriculum. “Being with one’s inner sensations is a primary skill for people recovering from PTSD.”

”Although content is important, in trauma-informed yoga instruction, *how* one teaches is more important than *what* one teaches,” Khalsa says. “We do avoid inversions and any requirement for fast movement. Pacing and finding one’s rhythm wins out over just about everything else. We keep the tone quiet and inner focused; no music, no strong directive language. Our goal is to increase the student’s capacity for stillness.”

”Practices that may be likely to induce hyperventilation (e.g., *kapalabhati, bhastrika*) are contraindicated,” according to Sovik. In some individuals, he finds that “supine reclining postures may lead to feelings of vulnerability. Supported prone poses may work better. This is a matter of experiment with each individual. In the beginning of breath training, it may be better to have clients sitting in a comfortable chair, listening to instructions with eyes open.”

In treating students with PTSD, Miller says, “It’s important to provide a safe environment where folks are able to place their backs to the wall and see all windows and exits. Make sure they know you’re watching the door in case someone tries to come into the room unannounced.” In addition, the yoga therapist needs “to proceed slowly and systematically,” because introducing strong interventions without proper safeguards can trigger overwhelming emotional responses.

Figure 6.1
Side-lying *savasana* with the back against a wall may lessen feelings of anxiety.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Lasater often recommends supine savasana, ideally done for 20 minutes every day, for anxiety disorders. In students who can't tolerate this, however, she has had good luck with side-lying savasana (see Fig. 6.1) "with the student's back against the wall so they feel safe."

Resources

Book: *Moving Inward* by Rolf Sovik

Book: *The iRest Program for Healing PTSD* by Richard Miller

Book: *Overcoming Trauma through Yoga* by David Emerson and Elizabeth Hopper

Book: *Yoga Skills for Therapists* by Amy Weintraub

Book: *Relax & Renew* by Judith Hanson Lasater

CHAPTER SEVEN

YOGA THERAPY FOR OTHER MENTAL HEALTH CONDITIONS

S VARAMBALLY • BM KUTTY • BN GANGADHAR

Introduction

Yoga is a time-tested system originally designed for aiding spiritual progress, and traditional texts refer to the effects of yoga on calming the disturbed mind. Different components of yoga are being increasingly utilized as therapeutic tools in various physical and mental disorders all over the world. Over the past two decades, a number of studies showing the effectiveness of yoga-based interventions for depression and anxiety have been published, but the use of yoga practices for other mental disorders such as schizophrenia is now receiving attention (Cramer, Lauche, Klose, Langhorst, & Dobos, 2013). Schizophrenia, a social brain disorder, is a disabling illness that has roots in different pathophysiological processes. Neuroplastic deficiency, chronic inflammation and its influence in different central nervous system (CNS) circuits are emerging as important. These processes are also relevant to aging and the attendant brain disorder dementia. Psychiatric disorders such as addiction also have a basis in subtle brain dysfunction; heightened activity of the limbic system is one such dysfunction. Maintaining attention is a central function of the healthy brain, and deficits in this process manifest in children (and even in adults) as a form of hyperactivity or restlessness.

Currently available treatments for these disorders, drugs in particular, offer some benefits, but at the cost of unwanted side effects. In many situations, the drugs merely address symptoms because the cause of illness is unclear. Failure to address the intrinsic biological basis (if not the cause) is a limitation of drug therapy that is often highlighted by critics. Patients and families, therefore, frequently seek alternative or complementary treatment approaches. Surveys point to the prevalence of such interventions in a substantial proportion of patients; yoga is one such intervention (Telles & Singh, 2013). More recent research using state-of-the-art technology points to significant neurobiological effects of yoga (Kalyani et al., 2011; Streeter et al., 2007). Yoga has the potential to influence several brain processes, from attention to plasticity, and hence is a therapeutic intervention that deserves exploration. Indeed, clinical evidence points to this promise for yoga in psychiatry.

Scientific and psychophysiological rationale for the use of yoga for mental health disorders

Meditative techniques provide intense sensory, emotional, and cognitive experiences and they influence body and brain physiology in a variety of ways, such as increased synchronization between central and peripheral autonomic networks. Meditation modulates attention and emotion systems and establishes a wakeful hypometabolic state with parasympathetic predominance. Yoga has a meditative component, and the common outcomes of sustained yoga practice range from experiencing deep relaxation, positive attitude, enhanced self-regulation, emotional stability, and resilience to stress to developing altruistic behavior and personal growth.

Enhanced parasympathetic nervous system (PNS) activity induced by meditation practice is reflected at the subjective level as a sense of well-being and positive affect. It is correlated with high left prefrontal activation and improvement in hormonal and immune system functioning (Davidson, et al., 2003). The neurophysiological mechanisms underlying the subjective enhancement of psychological well-being and cognitive benefits include the activation of attention networks, involving the anterior cingulate cortex (ACC), the insula, and the fronto-parietal attention and fronto-limbic affective systems (Rubia, 2009). Hypo-activation of the ACC is implicated in various mental disorders such as attention-deficit hyperactivity disorder (ADHD), addiction, dementia, depression, and schizophrenia. The fronto-midline theta activity originating from the ACC and prefrontal cortex enhances PNS activity, emotion processing, and sustained attention as well as a feeling of happiness and internalized attention (Cahn & Polich, 2006), indicating that practice of yoga and meditative techniques might yield promising results in these disorders.

Altered neurotransmitter levels are reported in many psychiatric disorders. Low levels of brain-derived neurotrophic factor (BDNF), a marker of neuronal plasticity, have been shown in depressed patients. Reduced levels of gamma-aminobutyric acid (GABA) are seen in depression, anxiety, epilepsy, and insomnia. ADHD has been linked to reduced dopamine and reduced fronto-parietal network activity during attention-related tasks. Low levels of oxytocin are linked to impaired social cognition among individuals with autism and schizophrenia.

On the other hand, enhanced oxytocin and GABA levels are associated with increased PNS functions (Khattab, Khattab, Ortak, Richardt, & Bonnemeier, 2007). Practice of yoga postures is reported to elevate mood, help cope with challenges, and reduce anxiety by modulating neurotransmitter release and in turn influencing hormone and immune functions. Yoga techniques were shown to enhance levels of oxytocin (Jayaram et al., 2013) and GABA (Streeter et al., 2010), leading to improved social cognition and enhanced coping. Yoga practices such as Kirtan Kriya reduced proinflammatory factors such as NF-kB and interferon response factor (Black et al., 2013) and enhanced telomere length as well as telomerase activity (Lavretsky et al., 2013) among dementia caregivers, besides improving coping and quality of life. Reduced cortisol and epinephrine and increased adiponectin and BDNF have been linked to relaxation and stress relief (Eyre & Baune, 2013; Kiecolt-Glaser et al., 2012). Improved psychological status following yoga practice in victims of natural calamities, war, violence, and detention suggest a global regulatory approach for yoga in establishing mind–body harmony.

Structural brain changes are also noted with long-term meditative and yoga practices. Long-term practice of mindfulness meditation increases the cortical thickness of areas associated with interoception, attention, and sensory and cognitive processing; a cortical remodeling process was proposed as a means of neuroprotection against age-associated thinning of cortical tissues (Lazar et al., 2005). The neurosenescence mitigating property of yoga practices has been correlated with enhanced hippocampal volume (Hariprasad et al., 2013b). Meditative practices improve sleep quality and sleep architecture (Manjunath & Telles, 2005; Ravindra et al., 2010).

Thus, a growing body of evidence supports the therapeutic effectiveness of a wide variety of meditative and yoga techniques in the treatment of psychiatric disorders used as complementary treatment approaches. A better understanding of the psychophysiological mechanisms underpinning specific behavioral and cognitive effects for each technique would provide wider scope and better clinical effectiveness in the treatment of mental disorders.

In summary, meditative and yoga practices produce a continuum of global regulatory changes at the physical, cognitive, and emotional levels and bring about behavioral traits associated with better cognition, relaxation, and a more positive outlook. Studies on the clinical application of meditative practices offer great promise; more randomized controlled trials (RCTs) are required to prove their benefits in psychotherapeutic programs.

Yoga for psychosis

Psychoses, especially the chronic forms such as schizophrenia, are one of the severe mental disorders. Psychosis carries stigma and causes significant morbidity as well as disability. Lifetime prevalence of psychosis has been reported to be more than 3% of the general population worldwide (Perala et al., 2007). One of the important facts about psychosis is that it sets in early in the productive years (typically, the late second decade), causing significant disruption in personal, professional, and family life. Only a minority of individuals will have a remitting course, and the majority (> 60%) will have a relapsing course with or without severe deficits. Psychosis has different symptom dimensions, among which the positive symptoms (delusions, hallucinations, and formal thought disorder) are easily identifiable and respond fairly well to available treatments. However, it is now well recognized that the negative symptoms (amotivation, anhedonia, emotional blunting, and poor insight) and cognitive deficits are also primary features of psychosis, and may even precede the onset of positive symptoms by months or years. These dimensions are less responsive to available treatment options and cause more disability than positive symptoms. Along with subtle neurocognitive deficits, specific deficits in social cognition have been demonstrated in these individuals, which significantly influence real-world functioning and prognosis. Treatment options for psychosis increased significantly in the last two decades, but appear to have reached a deadlock in recent years. Aside from suboptimal efficacy, particularly for negative and cognitive symptoms, medications also cause a variety of adverse effects, ranging from extrapyramidal side effects of the older antipsychotics to metabolic, cardiac, and hormonal effects of the second-generation drugs. Hence, complementary treatment options have emerged as a critical area of research, yoga being one of them. Yoga therapy has demonstrated success in decreasing stress, and in improving mood, cognition and quality of life. However, yoga therapy for psychosis remained largely unexplored until recently, possibly due to an assumption that patients with psychosis may not be able to follow yoga protocols, along with reports that some meditative practices may worsen or provoke psychotic symptoms.

Randomized controlled trials of yoga in schizophrenia

An RCT by Xie et al. (Xie, Lin, Guo, & Chen, 2006) used a yoga practice for 8 weeks for 90 patients with schizophrenia and found improvements in physical and psychological functioning as well as quality of life. A specific yoga-based module for psychosis was used in an RCT published in 2007 (Duraiswamy, Thirthalli, Nagendra, & Gangadhar, 2007). This study had 41 consenting outpatients who had moderate symptoms on stabilized antipsychotic therapy. Subjects were randomly allotted to either a yoga intervention or a standard set of physical exercises and were trained for 1 month (at least 12 1-hour sessions) in each of these two by certified instructors. The patients were advised to continue the practices at home for the next 3 months. No change was made as regards their drug treatment. Patients' clinical state as well as social function was assessed at baseline and after 4 months by a psychiatrist uninvolved in treatment allocation. Although negative syndrome and social dysfunction scores dropped in both groups over the 4 months, the yoga group performed better. Limitations of this study included modest sample size, lack of a nonintervention control group, and no assessment of cognition. An RCT including 49 patients compared the effects of a single 30-minute hatha yoga session with a 20-minute aerobic exercise session and a 20-minute reading session and found that both yoga and exercise groups had decreased state anxiety, decreased psychological stress, and increased subjective well-being compared to the control condition (Vancampfort et al., 2011). Another study including 18 institutionalized patients with schizophrenia also documented improvement in symptomatology and quality of life, but called for larger and better-controlled studies to confirm the findings (Visceglia & Lewis, 2011).

Extending the earlier work (Duraiswamy, Thirthalli, Nagendra, & Gangadhar, 2007), the group at NIMHANS (National Institute of Mental Health and Neurosciences) conducted a larger RCT including 120 consenting patients stabilized on antipsychotic medications. This study had three arms: yoga, physical exercise, and waitlist. The yoga therapist ensured that they attended at least 12 classes in the first month. The yoga therapist's judgment of learning yoga asana well enough to be practiced at home was satisfactory in all patients. More patients in the yoga group improved than in the other two groups, particularly in negative symptoms and socio-occupational functioning (Varambally et al., 2012). Odds ratio analysis revealed that the likelihood of improvement in the yoga group in terms of negative symptoms was about five times greater than the waitlist group and the exercise group.

A small RCT looked at the effect of yoga on subjective well-being and basic living skills in 30 inpatients with schizophrenia. This study found significant improvement in subjective well-being and activities of daily living as well as reduction in disability after a month of yoga practice (Paikkatt, Singh, Singh, & Jahan, 2012). However, a recent single-blinded RCT that used weekly 1-

hour hatha yoga sessions as an adjunct to regular treatment for 8 weeks found no positive changes in resilience level or stress markers. The authors commented that the duration and intensity of yoga sessions and the focus on patients with chronic illness might explain the negative observations (Ikai et al., 2014).

A systematic review of the benefits of physical therapy for people with schizophrenia included several of the above yoga studies and found that physical interventions offered added value as part of a multidisciplinary approach (Vancampfort et al., 2012). A review of mind–body medicine for psychosis (Helgason & Sarris, 2013) found positive evidence for meditative techniques and yoga. A systematic review and meta-analysis published in 2013 (Cramer, Lauche, Klose, Langhorst, & Dobos, 2013) included five RCTs with a total of 337 patients (Table 7.1 , p. 127). This review found moderate evidence for short-term effects on quality of life compared to usual care, but no other significant effects. Based on some of the studies reviewed above, the National Institute for Health and Care Excellence (NICE) guidelines for management of schizophrenia issued in February 2014 recommended yoga as a complementary intervention, but also emphasized the need for more systematic research in this direction (http://guidance.nice.org.uk/CG178).

Most studies in schizophrenia tested yoga in outpatients with schizophrenia who were stabilized on psychotropics for a long time. A recent study endorses the role of yoga in the acute phase of inpatient treatment in psychosis (Manjunath, Varambally, Thirthalli, Basavaraddi, & Gangadhar, 2013). However, lasting effects in reducing chronicity by such early introduction of yoga is an area that deserves investigation. An important point to be noted in these studies is that the components of the yoga modules were mainly asana and pranayama. Meditation practices were avoided in view of possible provocation of psychosis, as well as nonverifiability.

Effect of yoga on cognition in schizophrenia

In the study by Varambally et al. (2012), a social cognition test was performed at baseline and at the end of the study. This test measured the patient's ability to recognize facial emotions. The tool used was standardized with Indian patients: Tool for Recognition of Emotions in Neuropsychiatric Disorders (TRENDS) (Behere, Raghunandan, & Venkatasubramanian, 2008). Standardized images of faces with different emotions were presented, and the subject was expected to recognize the emotion being portrayed. The sum of accurate recognitions yielded the TRENDS Accuracy Score (TRACS). The patients in the yoga group had lower TRACS than the control group at baseline. The TRACS improved in the yoga group from baseline to the second month as well as to the end of the study, and the improvement was significant. No such significant change occurred in either exercise or waitlisted patients (Behere et al., 2011). Jayaram et al. (2013) propose that the effects of yoga on cognition can be explained by yoga increasing levels of oxytocin in the blood of practitioners after regular practice (Jayaram et al., 2013). Another study from India looking at yoga as a cognitive remediation technique in patients with schizophrenia and bipolar disorder (Bhatia et al., 2012) documented the positive effects of a yoga intervention on several cognitive functions, especially in schizophrenia.

Yoga for insomnia

Insomnia has been a clinical problem for centuries, and there is scarcely any modality of treatment that has not been tried for its amelioration, ranging from simple measures such as physical exercise to combinations of medications. *Insomnia disorder* is the new terminology in the DSM-V (American Psychiatric Association, 2013) to describe significant difficulties in sleep. Though many medications are available to help relieve insomnia, the adverse effects of these have caused clinicians to look for other methods of helping patients with this difficult problem. Yoga and meditation-based techniques have been in the forefront of research in this area.

Improvement of sleep parameters has been shown in healthy subjects with cyclic meditation (Patra & Telles, 2009) and in elderly subjects with Silver Yoga exercises (Chen et al., 2009). An RCT of a specific yoga module designed for the elderly improved both sleep and cognitive parameters (Hariprasad, Arasappa, Varambally, Srinath, & Gangadhar, 2013). A study in 20 subjects with chronic insomnia reported improvements in sleep efficiency, total sleep time, total wake time, sleep-onset latency, and wake time after sleep onset at end-treatment as compared with pre-treatment values (Khalsa, 2004). An RCT used ayurveda and yoga interventions for 120 elderly subjects with insomnia and found medium-to-large effect sizes for benefits of yoga therapy on latency, duration, and quality of sleep (Manjunath & Telles, 2005). A study on 14 older women with osteoarthritis and sleep disturbance found significant improvements on the Insomnia Severity Index and diary-reported sleep-onset latency, sleep efficiency, and number of nights with insomnia after 8 weeks of a yoga intervention (Taibi & Vitiello, 2011). Another RCT in postmenopausal women with insomnia randomly assigned subjects to control, passive stretching, and yoga groups. Among the 44 volunteers who completed the trial of 4 months, compared to the control groups, the yoga group had significantly lower posttreatment scores for climacteric symptoms and insomnia severity and higher scores for quality of life and resistance phase of stress (Afonso et al., 2012).

A recent waitlist-controlled trial in older adults with insomnia found significant improvements in a range of subjective factors, including overall sleep quality, sleep efficiency, sleep latency and duration, and self-assessed sleep quality in the yoga group as compared to controls (Halpern et al., 2014). A review found reasonable evidence that yoga and other mind–body interventions were able to improve sleep efficiency and total sleep time, but the authors commented that studies with better methodology were needed (Kozasa et al., 2010). A systematic review of CAM (complementary and alternative medicine) therapies for sleep (Sarris & Byrne, 2011) also found evidentiary support for yoga in the treatment of chronic insomnia.

In summary, there has been theoretical and promising practical support for the benefits of yoga and meditation-based interventions for insomnia, but more systematic work remains to be done.

Yoga for attention-deficit hyperactivity disorder

ADHD has been one of the most difficult psychiatric disorders to treat in children, owing to both the nature of the symptoms and the controversies regarding the use of stimulant medications and their adverse effects**.** Yoga and meditative practices have therefore been explored as sole or adjunct interventions for ADHD. Perhaps the first RCT was by Jensen and Kenny (Jensen & Kenny, 2004) in which boys diagnosed with ADHD and stabilized on medication were randomly assigned to a 20-session yoga group (n = 11) or a control group (cooperative activities; n = 8). The yoga program consisted of respiratory training, postural training, relaxation training, concentration training, and a technique called *trataka* (gazing intently with an unwavering gaze at a small point until tears are shed). The yoga group obtained significant benefits on five subscales of the Conners' Parent Rating Scale (CPRS): The authors suggest that yoga may have merit as a complementary treatment for boys with ADHD already stabilized on medication, particularly for its evening effect, when medication action is on the wane or absent. However, the authors cautioned that the results need to be replicated in larger groups with a more intensive supervised practice program. The limitations of this study included low statistical power and inconsistency of home practices. Haffner (Haffner, Roos, Goldstein, Parzer, & Resch, 2006) included 19 children (12 boys and 7 girls) diagnosed with ADHD and used a 2 × 2 crossover design comparing yoga training (n = 8) versus regular physical exercise (n = 11) over 8 weeks. Eight of the 19 children were also on medication, and 7 received other complementary therapies as well. Results showed that yoga training was superior to the conventional motor training on both test scores on an attention task and parent ratings of ADHD symptoms, with effect sizes in the medium-to-high range (0.60–0.97).

A Cochrane review in 2010 (Krisanaprakornkit, Ngamjarus, Witoonchart, & Piyavhatkul, 2010) concluded that there was insufficient evidence to support the effectiveness of any type of meditation for ADHD given that the four RCTs above were relatively small in size and limited in design, with inconsistent results across the outcomes. A school-based study by Mehta et al. (2011) assessed the efficacy of a 6-week multimodal peer-mediated behavioral program that included yoga for children between 6 and 11 years of age diagnosed with ADHD. The authors employed performance and behavioral scores as measured by the Vanderbilt. The 1-hour program (twice-weekly sessions) combining yoga, meditation, and play therapy, was taught by trained high school volunteers. The study included 76 school children. After 6 weeks of the program, 90.5% of the children showed reductions in performance-impairment score, a measure of academic performance. The study also demonstrated that children could successfully learn both yoga and meditation from high school students irrespective of their age, ADHD type, or initial performance impairment, making it feasible as well as cost-effective in schools. Sixty-nine of these children were followed up with weekly sessions for 1 year, and the improvement on the performance-impairment scores for ADHD were sustained through the 12 months in 85% of the students. Most (92%) of the students also had improvements in their Vanderbilt scores as assessed by parents. These results further demonstrated the efficacy and cost-effectiveness of the program (Mehta et al., 2013).

A recent open-label exploratory study included nine patients with moderate-to-severe ADHD (eight were on medications) admitted in a child psychiatry ward (Hariprasad, Arasappa, Varambally, Srinath, & Gangadhar, 2013). The participants were taught a specific yoga intervention by a trained yoga therapist daily during their inpatient stay and were assessed at the end of the first, second, and third months by an independent rater. An average of eight yoga-training sessions were given to subjects, who were able to learn yoga reasonably well. There was a significant improvement in their ADHD symptoms at the time of discharge. In summary, yoga therapy for ADHD is feasible in both hospital and school settings. Yoga may be used as a sole or an add-on treatment along with medications as a part of a multimodal intervention.

Yoga for substance-use disorders

Different yoga programs have been explored as an interventional strategy in patients with substance abuse. A study published in 1997 (Shaffer, LaSalvia, & Stein, 1997) found that hatha yoga therapy was comparable to conventional methadone treatment with traditional group psychotherapy in 61 randomly assigned clients on a variety of psychological, sociological, and biological measures. A study using Sudarshan Kriya (SK) and pranayama (P) in cancer patients with nicotine addiction who had completed their standard therapy found that SK and P helped to control the tobacco habit in 21% of individuals, who were followed up to 6 months of practice (Kochupillai et al., 2005). A study from India evaluated a 90-day residential-group pilot treatment program for substance abuse that incorporated a comprehensive array of yoga, meditation, spiritual, and mind–body techniques (Khalsa, Khalsa, Khalsa, & Khalsa, 2008). Subjects showed improvements on a number of psychological self-report questionnaires, including the Behavior and Symptom Identification Scale and the Quality of Recovery Index. A study using 10-minute yogic breathing exercises in abstaining smokers showed acute effects in reducing craving compared to a control group who watched videos (Shahab, Sarkar, & West, 2013). Another study, which explored the feasibility of a 10-week yoga package as part of a treatment program for 18 patients with alcohol dependence, found it to be a feasible and well-accepted adjunct treatment for alcohol dependence, but found no significant difference between yoga and treatment as usual in terms of reduction in alcohol consumption. The authors concluded that larger studies are needed to adequately assess the efficacy and long-term effectiveness of yoga as an adjunct treatment for alcohol dependence (Hallgren, Romberg, Bakshi, & Andreasson, 2014). A recent narrative review summarized the philosophical origins, current scientific evidence, and clinical promise of yoga and mindfulness as complementary therapies for addiction (Khanna & Greeson, 2013). A comprehensive 10-year review of evidence for yoga interventions for smoking cessation reported that the majority of the interventions were able to enhance smoking cessation rates and that yoga-based interventions hold promise for helping people to quit smoking (Dai & Sharma, 2014). However, the authors listed some limitations, such as short follow-up measurements and short duration of interventions. A current research study (BreathEasy study) attempts to address some of these issues through a rigorous RCT examining the efficacy of Iyengar yoga as a complementary therapy to cognitive-behavioral therapy for smoking cessation with follow-up through 12 months (Bock, et al., 2014).

Yoga for cognitive disorders

There is a sizable amount of literature demonstrating the effects of yoga on cognitive parameters in healthy individuals, especially in the elderly (Hariprasad et al., 2013a), and in subjects with primary psychiatric disorders such as depression (Sharma, Das, Mondal, Goswami, & Gandhi, 2006) and psychosis (Bhatia et al., 2012). Preliminary studies looking at the effect of a meditation program on regional blood flow and neurocognitive measures in subjects with memory loss have shown promise (Newberg, Wintering, Khalsa, Roggenkamp, & Waldman, 2012). In summary, there is early and promising evidence that meditation- and yoga-based interventions can positively impact cognitive disorders, and this is an area that holds great scope and potential for research.

Yoga for somatoform disorders

Yoga has been used as a therapy for low-back pain for several decades, with strong evidence for both short- and long-term reductions in pain. An RCT on 150 female patients with menstrual disorders and somatoform symptoms showed significant improvement in several somatoform symptoms after 6 months of yoga nidra therapy in comparison to the control group (Rani, Tiwari, Singh, Agrawal, & Srivastava, 2011). A recent open trial evaluated an integrated yoga therapy module in 64 patients with somatoform pain disorder at a tertiary neuropsychiatry center. The yoga intervention led to a significant reduction in pain scores and improvement in anxiety, sleep, and quality of life in patients who completed the study (Sutar, 2014). However, systematic and long-term studies are critical to establish the role of yoga in this common and widely prevalent group of psychiatric syndromes.

Challenges in yoga research

Research into the clinical applications of yoga (including meditation) is not without challenges. There are several schools of yoga and of meditation. Many yoga interventions combine meditation with asanas and pranayama, and studies have applied various combinations of these in different sets of practices. Despite this variation of interventions, the outcomes are similar in most studies, although not with comparable effect sizes. Replicability of findings with similar interventions is limited, and hence the skepticism in scientific circles. One of the important aspects of interventions in clinical samples (especially in psychiatric disorders) is verifiability of the procedure. The physical aspects of asanas are to a great extent verifiable. However, the mindfulness needed in each movement, and in the resulting posture for an effective practice, is not. Meditative processes are largely subjective, and the clinician has to depend entirely on the patient's report. In a disturbed state of mind, would the patient be able to apply his or her mind to these meditative techniques? Does meditative practice demand a "sound mind" and help best those patients who have recovered to stay well rather than those who are ill and need to recover? Would any form of yoga be applicable for all disorders? The challenge of answering these questions is difficult to overcome. Traditional texts speak of the benefits of yoga but do not address the issue of specific yoga practices for specific illnesses. This area is a fertile ground for the clinical researcher, and the results have the potential to optimize yoga in clinical practice.

Yoga interventions require that participants learn from an experienced yoga practitioner or yoga therapist. Traditional yoga schools in India advocate daily training followed by similar practice at home for optimal benefits, both for learning yoga practices and for yoga therapy. This appears to be the most common barrier in coming for yoga therapy in clinical settings (Baspure, et al., 2012; Sutar, 2014). In a typical hospital setting, if yoga is offered as an integrated intervention, most patients prefer infrequent sessions, for example, once a week or once a month. Daily training requires an inpatient facility in most cases. Psychiatric hospitals in most countries can ill-afford to keep patients who have improved well enough to practice yoga. More research is needed to evaluate patient-friendly yoga approaches, both in terms of frequency and ease of practice that can be applied in an institutional setting.

Yoga in psychiatry is also confronted by the placebo effect. Drug research allows refinements such as double-blinding (of both patients and clinicians) to overcome the placebo effect. Developing an appropriate control arm for yoga is a serious challenge. This is compounded by the lack of objective markers of the beneficial effects, so that clinicians have to depend on subjective reports of the patients. Recently, however, some markers—such as gray matter changes in magnetic resonance imaging (MRI), reductions in serum cortisol, and increase in amplitude of evoked potentials—are being employed as indirect markers of health improvement and hence supporting the benefits of yoga practices (Hariprasad et al., 2013b; Naveen et al., 2013). These more objective markers have the potential to overcome the clinician's bias and to help with blinding in trials. Many of these methodological challenges have been discussed in a recent review (Gangadhar & Varambally, 2011).

Other issues related to yoga in clinical practice meriting attention include interactions with drugs and other potential adverse effects of yoga practices. In addition to its direct therapeutic benefits, yoga has been much sought after for mitigating adverse effects of drugs, but little has been documented on adverse effects of yoga practices. Research in this direction is needed. Lastly, yoga is traditionally used as a spiritual way of life (blending the personal consciousness with the universal) (Varambally & Gangadhar, 2012). There could be several other benefits of practicing yoga and meditation that the clinical scales may not tap into, which may even be seen as side effects. Future research needs to find a way to overcome this limitation.

Table 7.1 Controlled studies of yoga as intervention in psychosis					
Author/year	**Sample**	**Yoga technique**	**Control**	**Duration of yoga**	**Results**
Xie et al., 2006	Schizophrenia (*n* = 90)	Yoga (postures, breathing techniques, meditation, relaxation)	Usual care	8 weeks	Physical and psychological functioning and quality of life improved in yoga group
Duraiswamy et al., 2007	Schizophrenia (*n* = 61)	Yoga module with asana and pranayama (*n* = 31)	Physical exercise (*n* = 30)	4 months	Patients in the yoga group significantly better in PANSS scores, functioning, and quality of life
Visceglia & Lewis, 2011	Schizophrenia (*n* = 18)	Personalized yoga module (*n* = 10)	Waitlist (*n* = 8)	8 weeks; twice-weekly sessions	Yoga group obtained significantly greater improvements in PANSS scores and perceived quality of life
Vancampfort et al., 2011	Schizophrenia or schizoaffective disorder (*n* = 49)	Single 30-minute yoga session (hatha yoga)	Single 20-minute session of aerobic exercise or reading	Single session	Yoga and aerobic exercise groups had decreased state anxiety, decreased psychological stress, and increased subjective well-being compared to control condition
Bhatia et al., 2012	Schizophrenia (*n* = 88)	Yoga module with asana and pranayama (*n* = 65)	Treatment as usual (*n* = 23)	3 weeks	Yoga group showed greater improvement with regard to measures of attention;

					changes more prominent among men
Varambally et al., 2012	Schizophrenia (*n* = 119) RCT; 3 groups	Yoga module with asana and pranayama (*n* = 46)	Physical exercise (*n* = 36) Waitlist (*n* = 37)	4 months	More patients in yoga group improved in PANSS negative and total scores and functioning
Manjunath et al., 2013	Non-affective psychosis (*n* = 88)	Yoga module with asana and pranayama (*n* = 44)	Physical exercise (*n* = 44)	6 weeks	Patients in the yoga group had (CGIS), PANSS total, and HDRS

ACC: anterior cingulate cortex; ADHD: attention-deficit hyperactivity disorder; BDNF: brain-derived neurotrophic factor; CGIS: Clinical Global Impression – Severity; CNS: central nervous system; CPRS: Conners' Parents Rating Scales; DSM-V: *Diagnostic and Statistical Manual of Mental Disorders* (5th edition); GABA: gamma-aminobutyric acid; HDRS: Hamilton Depression Rating Scale; IBMT: Integrated Body–Mind Training; MPH: methylphenidate; MRI: magnetic resonance imaging; NICE: National Institute for Health and Care Excellence; NIMHANS: National Institute of Mental Health and Neurosciences; PANSS: Positive and Negative Syndrome Scale; RCT: randomized controlled trial; SK: Sudarshan Kriya; TRACS: TRENDS Accuracy Score; TRENDS: Tool for Recognition of Emotions in Neuropsychiatric Disorders.

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Other mental health conditions: Clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Although insomnia can have many causes, Shanti Shanti Kaur Khalsa reports that “chronic stress and the tendency to minimize or dismiss personal needs, usually in order to meet work or family demands, are common threads. Shallow, rapid, and irregular breathing and restriction in the pelvic and thoracic regions and in the muscles of the spine, neck, shoulders, and ribcage are frequently seen. In addition, people with chronic insomnia tend to present as frustrated, discouraged, fretful, fatigued, depressed, and anxious. Chronic hyperarousal and feelings of defeat and hopelessness are also common.”

Among those with insomnia, Aadil Palkhivala often finds, “Neck tension, an agitated nervous system evidenced by quick, erratic movements, fast talking, and a slight tremor in the hands.” People with insomnia often show signs of increased *vata dosha* , for example, being unable, he says, “to complete one sentence or one thought completely before jumping onto another.” Palkhivala also finds some such students have an agitated mind, quickly angered or irritated—findings consistent with *pitta* elevations.

Khalsa says, “We address hyperarousal through rhythmic targeted movement, synchronizing breath and movement to restore the balance of endocrine and nervous systems, and a meditation specific to insomnia.” In the asana practice, students work “to open and lengthen the iliopsoas and the diaphragm.” For example, she often employs a cat-cow variation “where one leg is extended out and up on the inhalation into cow pose and the knee is brought to the nose on the exhalation into cat pose.” This is followed by *surya bhedana* (inhaling through the right nostril and exhaling through the left) and *balasana* (child’s pose).

The insomnia meditation Khalsa recommends is called *shabd kriya* . To do the practice, sit in any comfortable posture with an upright spine. Place the hands in the lap, palms turned up with the right hand placed over the left. The tips of thumbs touch each other, angling slightly forward (see Fig. 7.1). Focus the gaze on the tip of the nose with the eyelids halfway open. Inhale through the nose in four equal parts with a brief pause in between each one, mentally reciting one syllable of the mantra “*sa-ta-na-ma”* during each part of the inhalation. While retaining the breath inward (as long as doing so is perfectly comfortable), repeat this mantra four more times for a total of 16 beats. Exhale while silently chanting “*wahe guru.”* Continue this practice for 15 to 62 minutes.

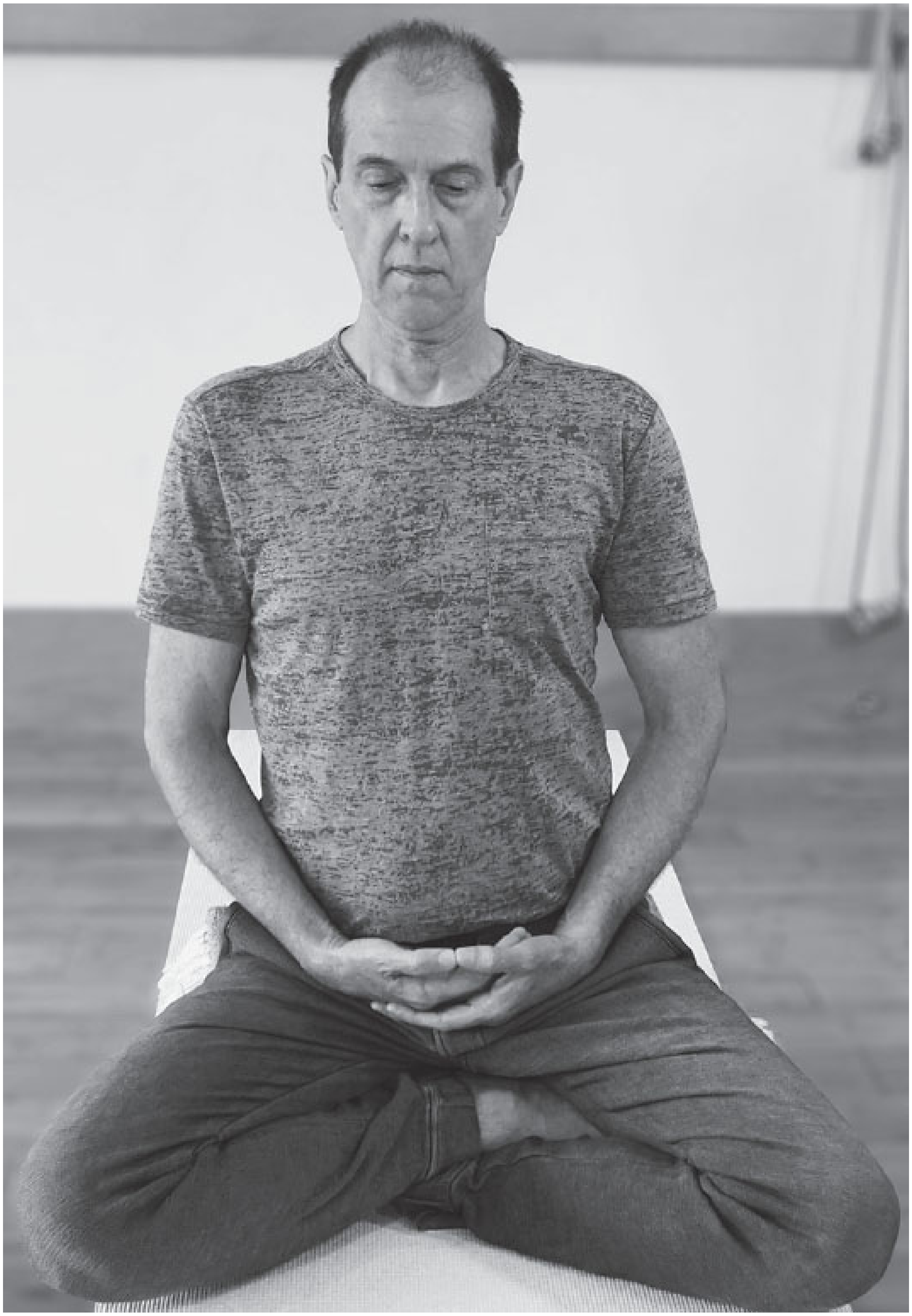

Figure 7.1
Shabd Kriya, used for insomnia.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Richard Miller suggests that if you can't sleep, "Get out of bed, do some hatha yoga and breathing, then go back to bed." Among the breathing practices, he suggests extending the exhalation relative to the inhalation, *chandra bhedhana* (inhaling through the left nostril and exhaling through the right), and *sitali* (inhaling through the mouth with the tongue rolled and exhaling through the nose). He has also had good luck with *brahmari* (bee breath) and with "simple sounds such as 'ah' that extend the exhalation while soothing the nervous system. Very gentle, soft, and polite *kapalabhati* helps relax the thinking mind."

Also often helpful, according to Miller, is systematic body-sensing, which supports deep relaxation. "Start body-sensing in the feet, and work up slowly, sensation-by-sensation, through the body to the jaw. Make sure all the senses are softening. Keep the various 'grasping' mechanisms soft," he says, including the jaw, ears, eyes, shoulders, and palms. "Softening these five quiets the thinking mind as this shifts thinking to sensing." Such body-sensing is typically part of the guided meditation practice *yoga nidra* (yogic sleep) he teaches.

Miller says, "Sleep practices need to be tailored to the individual. For instance, some need to start body-sensing in the feet, while others have more success beginning in the jaw. Breathing practices need to be adjusted for the individual. Breathing practices such as *bhastrika* (bellows breath) are contraindicated at nighttime, but can be practiced in the morning to refresh the body." He adds, “Regularity of practice of breathing, exercise, or hatha yoga, and regular practice of *yoga nidra* enable restful sleep patterns to be established.”

Another technique that Miller has had good luck with for those with chronic insomnia is the following: “When going to sleep, first lie on the back (supine) and extend the exhalation for 20 breaths. With each exhalation, feel out into the entire body, then out into the space around the body. Repeat while lying on the left side, then repeat while lying on the right side. If need be, continue rotating from backside, to left side, to right side, all the while inviting restful sleep.”

Palkhivala has found that vigorous styles of yoga “have often relieved enough of the built-up anxiety that the person sleeps better, due to exhaustion.” He suggests the practice be done “in two phases: first, active to relieve built-up tension and second, restorative.” Palkhivala says that “the restorative pose *shant sarovarasana* (still-lake pose) (see Fig. 7.2) has provided great easing of tension in the nervous system.” To do the pose, lie on your back with your knees bent, feet flat on the floor and slightly turned in. “Breathe emphasizing the exhalation,” he says, “with awareness of the abdomen rising and falling like the tide. Allow the feeling of the breath to gradually move deep into the belly towards the back so that the deep inner muscles can release.”

Figure 7.2

Still-lake pose may be useful in patients with insomnia.

Reproduced with permission from Aadil Palkhivala, WA, USA

Like insomnia, attention-deficit hyperactivity (ADHD) is, according to Timothy McCall, a condition commonly associated with mental agitation and sometimes profoundly increased *vata dosha* . “A lot of ADHD symptoms such as restlessness, distractibility, impulsiveness, and difficulty concentrating are textbook examples of what ayurvedic physicians call ‘vata derangement.’ One of the most important ways to address excess vata is to try to bring regularity to the schedule: whenever possible to eat at more or less the same time every day, and go to bed and rise at the same time, including weekends.”

“Ayurveda has many dietary suggestions for lowering vata, including trying to eat warm, unctuous, well-cooked meals, which are considered grounding.” McCall says, “I would also advise trying to eat mindfully, sitting down to eat—and not eating while driving, watching television, texting, or sitting at the computer.” Such multitasking, he says, believed to exacerbate vata imbalances, is ubiquitous in the modern world. “The more you can do one thing at a time, the better. Not all clients will be interested in pursuing such lifestyle changes, but even a few steps in the right direction—if done consistently—can help.”

As with insomnia, McCall says, “Calming practices like forward bends, gentle twists, and restoratives can be very helpful for people with ADHD, but many people with busy minds can’t settle into relaxation unless they burn off a little steam first. You can accomplish this with brisk walking, spirited dancing, or vigorous asana practices.” He warns, however, “Exercising to exhaustion may give temporary relief of symptoms, but paradoxically it will contribute to ongoing vata derangement. It’s best to exercise just long enough that practices that directly calm the nervous become more feasible.”

Resources

Audio: *Resting in Stillness* by Richard Miller

Book: *Kriya* by Yogi Bhajan

SECTION 3

MUSCULOSKELETAL AND NEUROLOGICAL CONDITIONS

From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.19b. © The Trustees of the Chester Beatty Library, Ireland.

CHAPTER EIGHT

YOGA THERAPY FOR BACK CONDITIONS

EJ ROSEEN • RB SAPER • KJ SHERMAN

Introduction – yoga therapy for back disorders

Yoga therapy has been used for several back disorders, including chronic back pain, hyperkyphosis, and scoliosis. Back disorders include structural and functional abnormalities as well as pain in the thoracic and lumbopelvic spine, including associated joints, muscles, ligaments, fascia, nerves, and other structures. Low back pain (LBP) is the most common back disorder. Specific causes (e.g., discogenic pain, spinal stenosis) account for roughly 15% of all back pain. The remainder lack a clear anatomic cause and are considered nonspecific (i.e., any number of structures could potentially contribute to the pain). LBP is often classified by the pain duration, with acute LBP lasting up to 6 weeks, subacute LBP lasting between 6 and 12 weeks, and chronic LBP persisting for at least 12 weeks (which is after any injured tissue should have healed). The prognosis for acute LBP is generally excellent, regardless of the treatment provided. Rates of recurrence are high (20–35%), however, and approximately 5–20% develop chronic LBP (Von Korff et al., 2005).

LBP has a lifetime prevalence of roughly 80%; therefore most adults will experience it at least once during their lifetime in the Western world (Balagué, Mannion, Pellisé, & Cedraschi et al., 2012). In the United States, it is the fifth most common reason for visits to primary care physicians and the most common reason for use of complementary and integrative therapies (Barnes, Bloom, & Nahin, 2008). Chronic LBP is the leading cause of pain and disability in the United States and worldwide, and is a top public health priority (Deyo, Mirza, & Martin, 2006; Murray & Lopez, 2013). Over the last several decades, disability associated with back pain has increased substantially along with the costs of managing this condition (Deyo, Mirza, Turner, & Martin, 2009). Despite a plethora of treatments for back pain, relatively little consensus exists regarding optimal treatment. In this chapter, we will summarize the evidence on the value of yoga for back disorders, focusing largely on chronic back pain because of its prevalence, the frustration many patients have with the lack of effective treatments, and the relatively large number of published trials.

Rationale of yoga for back pain

Since identifiable pathoanatomic causes of back pain are relatively uncommon, a biopsychosocial approach, rather than a traditional biomedical paradigm, is more appropriate for understanding useful approaches to treatment of nonspecific LBP (Weiner & Nordin, 2010). The biomedical paradigm is useful to rule out specific, albeit very rare, causes of LBP such as cancer, infection, compression fracture, and abdominal aortic aneurysm. This paradigm can also diagnose other definitive causes of LBP, including disc herniation with radiculopathy, spinal stenosis, and inflammatory arthropathies.

In the West, yoga practice typically combines postures (asanas) with other mind–body practices, typically rhythmic breathing (pranayama) and, less often, meditation. Additional components may include yogic philosophy, diet, and lifestyle. This multifaceted practice allows yoga to address multiple interrelated domains (i.e., physical, mental, emotional, social, cultural, spiritual), which may be important in managing chronic LBP. The multimodal nature of yoga parallels the biopsychosocial model. Although the specific mechanisms by which yoga helps back pain are uncertain, several effects of yoga are plausible contributors: increased physical activity, enhanced body awareness, reduced maladaptive movements, correction of postural strain, and relief of physical and mental stress. Specific conceptual models have suggested how these multiple therapeutic mechanisms may overlay and synergistically enhance the therapeutic effect (Sherman, Wellman, Cook, Cherkin, & Ceballos, 2010).

Physical activity

Exercise is effective as a standalone or conjunctive therapy for LBP. Physical exercise is one of the few proven treatments for chronic LBP, albeit with modest effects. No specific type of exercise has been shown to be clearly superior (Hayden, van Tulder, Malmivaara, & Koes, 2005). General exercise is often incorporated as a treatment option for LBP to reduce pain and increase functional status. Regular exercise supports general fitness and may successfully address perpetuating factors contributing to back pain such as sedentary lifestyle, obesity, and dynamic lumbopelvic instability.

In the West, yoga is often conceived as a form of exercise. Yoga can be modified to an individual's fitness level and is therefore accessible to most individuals. It can be practiced in various settings, such as yoga studios, gyms, community centers, and homes. Individuals can use yoga as a home-based long-term self-care strategy. Practicing yoga in the community allows the opportunity to have encouragement, guidance, and social support from an instructor and fellow classmates.

Reducing maladaptive movements and postures

The mindful practice of yoga may allow the participant to explore his or her movement patterns and find areas of tension, restriction, imbalance, and discomfort. Through prolonged stretching, strengthening, or repetitions of postures, body awareness may be enhanced. In this way, yoga may improve posture and movement patterns. Langevin & Sherman (2006) have proposed a model by which yoga may address behavioral and physical components of chronic LBP through improved movement patterns, connective tissue remodeling, and reducing soft tissue abnormalities (e.g., inflammation, nervous system sensitization). Yoga poses may target fascia or other soft tissues. The prolonged stretching and increase in range of motion may allow a lengthening or alteration of such tissues. This effect may be augmented by the use of supporting props such as straps or blocks.

Relief of physical and mental stress

Back pain is more likely to be persistent when comorbid psychosocial distress is present. Research on yoga for psychological health is growing, with promising evidence of benefit for depression (Balasubramaniam, Telles, & Doraiswamy, 2012), stress and anxiety (Vollestad, Nielsen, & Nielsen, 2012), and insomnia (Afonso et al., 2012; Khalsa, 2004). Yoga classes can also increase social connectedness and spirituality (Evans, Moieni, Subramanian, Tsao, & Sternlieb, 2011). Neuroanatomical studies have linked longitudinal yoga practice to increased thickness of cortical gray matter in brain areas associated with enhanced pain tolerance (Villemure, Ceko, Cotton, & Bushnell, 2014). Yoga has also been demonstrated to increase levels of neurotransmitters in the brain such as GABA (gamma-aminobutyric acid), the main inhibitory neurotransmitter in the brain (Streeter et al., 2007, 2010). Because low levels of GABA have been associated with depression and chronic pain, this may be one of several mechanisms by which yoga may relieve back pain (Streeter, Whitfield, Owen, Rein, Karri, & Yakhkind, 2012).

Longitudinal self-care strategy

Since LBP is often a chronic or recurrent concern, optimizing long-term outcomes requires an ongoing management strategy. Yoga is attractive as a self-care approach because it does not require seeing external providers, such as medical physicians, chiropractors, or acupuncturists. Over time, yoga may be able to improve all of the strongest contributing factors to LBP (i.e., sedentary lifestyle, obesity, postural strain, anxiety, depression). Consistent longitudinal self-care management with yoga may be required to achieve and maintain symptom resolution for many chronic LBP patients.

Review of yoga for back pain research

Chronic nonspecific low-back pain

Inclusion criteria for reviewed studies

This review and analysis of published randomized controlled trials (RCTs) on yoga for nonspecific LBP includes 12 RCTs that included at least one control group. We included RCTs of any size that measured any type of clinical back pain outcomes, but did not include nonrandomized studies or single-arm trials because they are methodologically weaker. Articles were retrieved via PubMed using the terms “yoga” and “low back pain” or “back pain.” Studies were also found by referencing recent meta-analyses and systematic reviews, searching clinicaltrials.gov and references in published reports, and through contacting content experts.

Table 8.1 (p. 146) describes the six RCTs that we considered large (i.e., *N* = 90–313) (Aboagye, Karlsson, Hagberg, & Jensen 2015; Saper, et al. 2013; Sherman, Cherkin, Erro, Miglioretti, & Deyo, 2005; Sherman et al., 2011; Tilbrook et al., 2011; Williams et al., 2009). In addition, six smaller RCTs (*N* = 12–80) met our inclusion criteria (Table 8.2 , p. 150) (Attanayake, Somarathna, Vyas, & Dash, 2010; Cox et al., 2010; Saper et al., 2009; Tekur, Singphow, Nagendra & Raghuram 2008; Tekur, Chametcha, Hongasandra, & Raghuram, 2010; Tekur, Nagarathna, Chametcha, Hankey, & Nagendra, 2012; Williams et al., 2005; Galantino et al., 2004).

Clinical practice guidelines (Chou et al., 2007; National Institute for Health and Clinical Excellence [NICE], 2009) and five systematic reviews were also identified, of which Cramer and colleagues (Cramer, Lauche, Haller, & Dobos 2013) performed a meta-analysis that included 10 of the 12 RCTs we describe in Tables 8.1 and 8.2 (pp. 146, 150), all of which were published prior to 2013. These RCTs used a number of different types of control groups, including no treatment, usual care, and less commonly education, exercise, or stretching classes.

We are aware of four other RCTs (Jacobs et al., 2004; Saper et al., 2014; Saper, 2015; Groessl et al., 2015). Jacobs et al. (2004) described their sample but never published their outcomes. The other three trials are still in progress.

Participant demographics

Of the 12 RCTs reviewed, 7 were conducted in the United States, 2 each in the United Kingdom and India, and 1 in Sweden. The mean age of participants, reported in 11 RCTs, was between 44 and 49 years. The twelfth RCT reported an age range of 30–49 for the 12 participants (Attanayake, Somarathna, Vyas, & Dash, 2010). All but one RCT had predominantly female participants (65–83%). One of the Indian RCTs (Tekur, Singphow, Nagendra, Raghuram, 2008) reported 46% female participants. Race was not reported in four RCTs, including all three RCTs performed in Europe. Among the others, four US RCTs included predominantly white participants (80–93%). Four RCTs enrolled 76–100% nonwhite participants: two RCTs from India and two performed in racially diverse US communities.

The definition of nonspecific LBP varied somewhat. All RCTs excluded patients with "red flag" signs of serious underlying pathology (e.g., tumor, infection, fracture, visceral disease), neurologic deficit, or other specific causes of back pain (e.g., disc herniation, spinal canal stenosis, ankylosing spondylitis). Nine RCTs included back pain lasting longer than 12 weeks. One RCT included LBP longer than 3 weeks. Another RCT required LBP duration greater than 6 months and one allowed nonspecific back pain of any duration. Patients with a history of previous spinal surgery were excluded from all but one trial, in which patients with back surgery were permitted to enroll only if the surgery was at least 3 years prior to enrollment. Two trials evaluated intensive residential yoga programs, whereas the remainder provided classes in outpatient settings.

Outcome domains

Primary and secondary outcome measures used in the RCTs are summarized in Tables 8.1 and 8.2 (pp. 146, 150). Primary outcomes were most commonly self-reported pain intensity and back-related disability, outcomes that have been recommended by expert panels for RCTs evaluating treatments for LBP (Bombardier, 2000; Deyo et al., 2014). Pain intensity was measured in nine RCTs. Four RCTs used an 11-point numerical rating scale and two used a mechanical visual analog scale (VAS). Two used the Aberdeen pain scale, which includes questions about symptoms and activities of daily living. One used a 5-point numerical rating scale (Attanayake et al., 2010). Back pain-related dysfunction or disability was collected as a primary or secondary outcome in all but one trial (Aboagye et al., 2015). The most common instruments used were the well-validated and reliable Roland Morris Disability Questionnaire (RMDQ), used in six RCTs, and Oswestry Disability Index (ODI), used in four RCTs. In addition, six RCTs recorded a variety of other disability-related outcomes, such as numbers of days in bed due to back pain, days when activities had to be restricted, or days unable to perform specific activities (e.g., walking, sitting, standing).

Health-related quality of life was reported in six RCTs, most commonly as a secondary outcome using the SF-12, SF-36, or WHO-QOL-BREF instruments. Aboagye et al. (2015) used the EQ-5D health status questionnaire as a primary outcome. Use of pain medications was reported in six RCTs. One RCT focused specifically on the cost-effectiveness of yoga as a treatment for back pain (Aboagye et al., 2015), while another included a cost-effectiveness analysis alongside the trial (Chuang et al., 2012). Other common secondary outcomes included functional measures (e.g., spinal flexibility), global improvement, participant satisfaction, and psychological symptoms such as anxiety and depression.

Feasibility

The feasibility of yoga as a therapeutic intervention in the context of RCTs can be inferred from data indicating that trials met their sample size goals, that class attendance was reasonable, and that the intervention was safe. The RCTs we have reviewed suggest yoga is feasible as an intervention for back pain in a variety of settings in North America, Europe, and India.

When available, adherence to the intervention protocol is reported in Tables 8.1 and 8.2 (pp. 146, 150). There is no one standard definition used for treatment adherence in these RCTs. This is likely due to the fact that the threshold for being adherent to a treatment typically depends upon the minimal effective dose. The minimal effective dose of yoga for persons with LBP is currently unknown. In trials to date, adherence has sometimes been defined a priori as attending at least 50% or 75% of all classes. Tables 8.1 and 8.2 (pp. 146, 150) indicate moderate adherence in those RCTs where it was reported. Saper et al. (2009) examined common reasons for not attending yoga classes in low-income populations and identified lack of time, transportation, and conflicting responsibilities as common reasons.

Most RCTs recommended home yoga practice, and to facilitate this, the researchers often provided aids such as handouts, CDs, or DVDs. Typically, RCTs recommended 20–60 minutes of daily practice and measured the frequency and amount of home practice using self-report logs. The relative therapeutic impact of in-class versus home practice yoga for back pain is unknown.

Adverse effects of yoga were reported in eight RCTs. Collectively, these trials found that yoga for chronic nonspecific LBP is relatively safe, with virtually all of the adverse events related to yoga being self-limited and mild. Temporary exacerbation of back pain, neck pain, sciatica, joint pain, and headache were the most common adverse events. However, these RCTs have used protocols developed by expert yoga teachers to select yoga poses and design sequences specifically for alleviating back pain. Conversely, postures that could potentially exacerbate back pain have been avoided. Thus, the safety of yoga for chronic LBP outside of the context of a clinical trial is unknown. Saper et al. (2013) reported one episode of cervical radiculopathy due to excessive neck extension during cow pose in a patient later discovered to have cervical spondylosis. Sherman and colleagues (Sherman et al., 2011) reported a disc herniation after the first class in a patient who previously had disc surgery. Tilbrook et al. (2011) reported that 12 (9%) of participants who attended at least one class experienced an adverse event resulting in increased pain possibly or probably related to yoga practice.

Results

Tables 8.1 and 8.2 (pp. 146, 150) display results from the 12 large and small RCTs reviewed, respectively. Cramer and colleagues' (Cramer et al., 2013) meta-analysis of 10 RCTs reported post-intervention short-term (as close to 12 weeks as possible) and long-term effects (as close to 12 months as possible) of yoga.

Primary outcomes

In the short term, Cramer et al. (2013) reported strong evidence that yoga reduced pain (standardized mean difference [SMD] = −0.48; 95% CI, −0.65 to −0.31; $p < .01$, 6 studies included), improved back-related disability (SMD = −0.59; 95% CI, −0.87 to −0.30; $p < .01$, 8 studies included) and was associated with global improvement (risk ratio [RR] = 3.27, 95% CI, 1.89 to 5.66) compared to controls. At longer-term follow-ups, Cramer et al. (2013) reported moderate evidence that yoga reduced pain (SMD = −0.33; 95% CI, −0.59 to −0.07; $p = .01$, 5 studies) and improved back-related disability (SMD = −0.35; 95% CI, −0.55 to −0.15; $p < .01$, 5 studies) compared to controls. They found no evidence for improvement of quality of life at either short- or long-term follow-up periods.

Secondary outcomes

Several RCTs of patients with chronic LBP found that the yoga group showed improvements in mood (Williams et al., 2009; Tekur, Nagarathna, Chametcha, Hankey, & Nagendra, 2012) and self-efficacy (Tilbrook et al., 2011, Sherman et al., 2013). Tekur and colleagues (Tekur et al., 2008; Tekur, Chametcha, Hongasandra, & Raghuram, 2010) reported increased active and passive range of motion when assessing lumbar spine flexibility and straight leg raise test, respectively.

Economic analyses

Two RCTs reported economic analyses of the value of yoga. Aboagye et al. (2015) evaluated cost-effectiveness from societal and employer perspectives as their primary outcome. When compared to self-care education, yoga was more costly for employers (₤150) but significantly less costly to society (₤2,124) over 1 year, reflecting less loss of work productivity for the yoga group. Chuang et al. (2012) in the United Kingdom reported that yoga compared to usual care was cost-effective from the perspective of both society (assuming a willingness to pay £20,000/additional quality-adjusted life year QALY) and the National Health Service (incremental cost-effectiveness ratio of £13,606/QALY).

Evaluating yoga protocols

Understanding various elements of yoga (e.g., styles, components, dose, method of delivery) is key to identifying a preferred therapeutic approach for chronic LBP. Table 8.3 (p. 152) describes the yoga protocols for the 12 completed RCTs, 3 RCTs in progress, and 1 completed RCT without reported outcomes.

Style of yoga

A range of yoga styles was used in the various trials. Although potentially important differences between the various yoga styles exist, we currently lack evidence suggesting that one is superior to the others. Among the 16 RCTs completed or in process, 8 used hatha yoga (Cox et al., 2010; Galantino et al., 2004; Groessl et al., 2015; Saper et al., 2009, 2013, 2014, 2015; Tilbrook et al., 2011), 3 used Iyengar yoga (Jacobs et al., 2004; Williams et al., 2005, 2009), 2 used Viniyoga (Sherman et al., 2005, 2011), 1 used Kundalini yoga (Aboagye et al., 2015), and 1 used Vivekananda Yoga Anusandhana Samsthana (VYASA) yoga (Tekur et al., 2008, 2010, 2012). One RCT provided insufficient detail to determine the yoga style (Attanayake et al., 2010).

Components of yoga

It is rare that all eight limbs of classical yoga are incorporated into back pain trials. Asanas and pranayama have been the most commonly included, although it is unknown if these specific components are the most beneficial for patients. Asanas were included in all RCTs and pranayama was reported in all but one RCT (Aboagye et al., 2015). Thirteen studies incorporated relaxation and, perhaps surprisingly, half of the trials introduced elements of yogic philosophy or lifestyle. Only five RCTs explicitly reported including meditation as part of the yoga classes (Cox et al., 2010; Galantino et al 2004; Groessl et al., 2015; Tekur et al., 2008, 2010, 2012; Tilbrook et al., 2011).

Dose and delivery of yoga

The yoga intervention period ranged from an intensive 1-week residential retreat to a 24-week outpatient program. Ten RCTs used a 12-week program. Excluding the two inpatient studies where yoga was practiced daily (Attanayake et al., 2010; Tekur et al., 2008, 2010, 2012), group yoga classes were held 1–2 times per week, with once per week being most common (9 studies). Class duration varied between 60 and 90 minutes. Thus, most RCTs included 12 hours of total yoga instruction in class (range 12–72 hours). In a study comparing yoga classes once versus twice weekly supplemented by home practice, Saper et al. (2013) found equivalent results for both doses. Nonetheless, they reported a modest dose-response relationship with improvements in back pain-related dysfunction after 9 classes and improvements in back pain after 12 classes.

Home practice

Home practice was encouraged in nearly all (15 of 16) of the RCTs. Home practice was also supported in 7 RCTs by providing participants with yoga supplies such as mats, blocks, straps, and blankets and was guided by printed manuals, CDs and/or DVDs. Patients were asked to maintain a log of their home practice in five RCTs.

Selection of instructors

The training requirements for instructors in yoga interventions varied substantially. Yoga instructors with various certifications were used in 10 RCTs. For example, of the 11 RCTs conducted in the United States, five required a 200-hour yoga teacher training registered with the Yoga Alliance (www.yogaalliance.org). The other trials required more basic training plus additional experience. Required minimum teaching experience for yoga instructors ranged from 2 to 10 years. A description of how yoga instructors were trained to deliver the study intervention was reported in 12 RCTs. The number of instructors delivering the intervention in RCTs was reported in 14 RCTs and ranged from 1 to 20. Typically, each class was taught by one instructor. However, some RCTs used multiple assistants (Williams et al., 2009) or included more than one instructor per class (Saper et al., 2009, 2013, 2014).

Yoga intervention fidelity

Yoga protocol fidelity was assessed in seven RCTs, primarily those published after 2008. Research investigators or yoga experts established protocol fidelity by observing one to two classes per cohort and reporting on agreement with protocol. Checklists were used in three RCTs.

Yoga for disc problems

We found one small clinical trial that evaluated yoga as a treatment for disc problems, which can cause both LBP and sciatica (Monro et al., 2015). The authors speculated that yoga may be beneficial for adults with disc extrusions and bulges because yoga could (1) reduce pressure on discs and improve circulation in the nearby joints, (2) release tense muscles and mobilize the joints gently, (3) strengthen core muscles and improve posture, (4) increase body awareness while performing postures and therefore increase safe range of motion, and (5) decrease the fear and anxiety associated with back pain and sciatica. The study included 61 adults recruited from rural India who were between the ages of 20 and 45 and had MRI-confirmed disc bulges or extrusions. Forty-five percent were female and over 80% had suffered from back pain or sciatica for at least one year. Participants were randomized to either yoga therapy or a usual care control. The yoga therapy intervention, developed by an orthopedic surgeon and adapted to the type and severity of back pain, consisted of postures, breathing, and relaxation exercises. Initially, the yoga was taught in classes, at least 2 per week for 2 weeks. Subsequent weekly classes were available for the remaining 10 weeks of the trial. In addition, all participants were asked to practice 15–30 minutes at home daily for the last 10 weeks of the trial. At the end of 3 months, back-related dysfunction, as measured by the RMDQ, was improved by a clinically important 3.3 points in the yoga group compared to controls. Pain scores, as measured by recording the worst pain in the past two weeks, did not show a significant difference between groups. No adverse events were reported. Longer-term follow-up data were not collected.

Yoga for hyperkyphosis

In 2002, Greendale and colleagues published a pilot study of 21 women over 60 years (mean age of 75 years) with hyperkyphosis, or excess forward curvature of the spine (Greendale, McDivit, Carpenter, Seeger, & Huang, 2002). Participants attended 12 weeks of classes including four series of modified classical yoga postures. The researchers found improvements in height and several functional tests. Greendale and colleagues (Greendale, Huang, Karlamangla, Seeger, & Crawford, 2009) speculated that yoga might improve posture in adults with hyperkyposis by “strengthening the spinal erectors and core muscles, stretching the muscles of the shoulder and hip girdles and retraining postures.” They then conducted a clinical trial including 118 adults over age 60 (mean age of 75.5 years) who had a kyphosis angle of 40 degrees or more. Individuals were randomized to 60-minute yoga classes 3 times per week for 24 weeks or a control group receiving a monthly luncheon and seminar coupled with regular mailings about health topics of interest to seniors (Greendale et al., 2009). Most participants were white (88%), female (81%), and relatively high functioning. Participants randomized to yoga attended a median of 79.9% of classes, with 50% attending at least 80% of classes. Yoga participants had significantly better improvement in kyphotic angle on two of the three measures of kyphosis, but not on the measure chosen as the primary outcome of kyphosis. There were no statistically significant differences in measures of physical performance or self-reported quality of life. The authors concluded that the improvement in flexicurve kyphosis angle suggested that hyperkyphosis can be improved by physical exercise such as yoga and recommended that future studies focus on adults with poorer functional status. A subset of 21 participants in the yoga arm of the hyperkyphosis clinical trial participated in a sub-study of upper-extremity function (Wang, Greendale, Kazadi, Salem, 2012). At the end of the 24-week intervention, participants improved in two of three measures of scapular function.

Yoga for scoliosis

No clinical trials have studied the efficacy of yoga for scoliosis. Fishman, Groessl & Sherman (2014) published from a single clinic a case series of 25 patients with scoliosis who were asked to practice a slight modification of the Iyengar “plank pose” on a daily basis. In that study, improvement, as measured by the Cobb angle on spinal radiographs, was found for patients with idiopathic or degenerative scoliosis. Although the mean improvements were clinically important, further research using more rigorous research designs is needed before robust conclusions can be drawn about the effectiveness of yoga for scoliosis.

Yoga for other back pain conditions

One RCT was identified evaluating yoga for back pain experienced during pregnancy. A pilot study of 60 pregnant women from Brazil found yoga was superior to postural orientation for pain relief and provocation of postural lumbar, but not pelvic, pain (Martins & Pinto e Silva, 2014). However, the study results were not clearly reported and there was high loss to follow-up, especially in the yoga group. Further studies are required to confirm or refute these results.

We could not identify any controlled or uncontrolled clinical trials that assessed the safety and effectiveness of yoga for the treatment of acute LBP, prevention of recurrent episodes of LBP, lumbar spinal canal stenosis, thoracic back pain, failed back surgery syndrome, or ankylosing spondylitis.

Summary

To date, scientific research has been published evaluating yoga for a number of back-related problems, including nonspecific LBP, discogenic LBP, hyperkyphosis, and scoliosis. The amount and quality of the evidence varies from 12 trials with a total of 1221 patients for nonspecific LBP to a convenience sample of 25 consecutive patients with scoliosis from a single medical practice. Taken together, these studies strongly suggest that yoga has an important role to play in the management of back problems for adults who are willing to practice yoga. The quality and quantity of the evidence is strongest for nonspecific chronic LBP, which is by far the most common back problem worldwide. In addition, there are several large trials currently in progress that will extend our understanding of the value of yoga for nonspecific chronic back pain for minority populations and veterans. These findings corroborate and strengthen the conclusion by Chou and colleagues (Chou, et al., 2007) that there is “fair evidence” that yoga is moderately effective for chronic LBP. We think that the current literature is consistent with “good evidence” that yoga is moderately effective for chronic LBP, based on the relatively large number of high-quality trials and their broadly consistent findings of benefit (Cramer et al., 2013). Moreover, yoga for back pain appears to be a safe intervention in the context of clinical trials with carefully selected postures and well-trained instructors. As is true with other forms of exercise, the most common adverse event for yoga is increased pain that typically resolves quickly.

Yoga is currently being implemented in some medical and physical therapy settings for patients with chronic LBP, and the research literature supports such practice. However, it is important to note that yoga was only clearly superior to conventional exercise in one (Tekur et al., 2008, 2010, 2012) of the four studies (Aboagye et al., 2015; Sherman et al., 2005, 2011; Tekur et al., 2008, 2010, 2012) that have compared both interventions. Yoga appears to have the strongest, most consistent benefits on reducing back-related dysfunction, with slightly less consistent benefits for reducing pain. Among patients with nonspecific LBP, fewer trials have evaluated yoga’s effects on quality of life, mood, medication usage, and days of restricted activity. Two trials have found yoga to be cost-effective for patients with chronic LBP.

Trials of yoga for back conditions have been conducted in the United States, Europe, and Asia. Most trials have recruited patients from primary care practices and general advertisements to the population at large. Therefore, the value of yoga for patients with severely disabling back pain seeking specialist care is unknown. Although some trials have followed patients for up to a year (which is typically standard in intervention trials for back pain), most have not. No trials of yoga for back pain have focused exclusively on yoga for spinal stenosis.

The trials of yoga for nonspecific LBP have mostly included participants with pain lasting more than 12 weeks and have rarely distinguished between lumbar pain and sacral pain, a distinction considered important in some styles of yoga (Kraftsow, 1999). The trials have used various different styles of yoga and a variety of postures. Across studies, the postures have overlapped but have not been identical. However, it appears that most postures have targeted the same muscle groups. Although no study has directly compared different styles of yoga for back pain or different sets of postures, the evidence suggests that a variety of styles and postures may be helpful for patients with nonspecific back pain. Conversely, no evidence suggests that one yoga style is superior to another for back pain.

The one trial of yoga for discogenic pain found benefits, but it needs to be replicated in a larger population. The largest trial of yoga for hyperkyphosis showed some, but not consistent, benefits for yoga and would require additional, larger trials to assess the benefits adequately. The case series of a single yoga posture for scoliosis is intriguing, but substantially more work is needed before yoga can be routinely recommended for this condition.

Suggestions for future research

In India, studies of yoga for nonspecific chronic back pain should include more than week-long retreats and if possible include a year-long follow-up period. In Asia, yoga has become popular outside of India, and studies in other countries, including China for example, are needed.

In Western countries, additional studies focusing on yoga for back pain in special populations are needed. Such studies should include patients recruited from pain clinics, military personnel, pregnant women, individuals with failed back surgery syndrome, and older adults, especially those who have various mobility issues and/or multiple chronic comorbidities. Two trials are currently in progress evaluating yoga for veterans with back pain.

Few published RCTs have included a full 12-month follow-up period. Since many people with LBP have intermittent, persistent, or continuous pain, more studies are needed that include 12-month outcomes and evaluate strategies to support adherence to long-term practice.

No large observational studies have examined outcomes of yoga for patients with LBP in yoga studios and other settings where yoga is currently offered. Such pragmatic studies would add valuable information on the safety and effectiveness of community-based yoga classes that are currently available for those with LBP. It might also add data on the value, if any, of yoga for those with acute LBP, where the prognosis is often excellent without any treatment.

Further research is needed on the optimal integration of yoga into care for chronic LBP. For example, examining the benefits of a stepped-care model compared to a “one-size-fits-all” yoga class would be useful. The stepped-care model might start all patients in a general beginning yoga class or a general “yoga for backs” class. Patients who do not improve would then receive a higher level of care by seeing a yoga therapist for one-on-one sessions to create an individualized practice. Another important study would be to use the “STarT Back Tool” (Hill et al., 2011) to stratify patients into low, medium, and high complexity and associated likelihood of chronicity. Different yoga interventions would be targeted to each level to determine whether a stratified approach improves outcomes. It will be useful to know whether the benefits of yoga can be enhanced by extending the number of weeks of classes by adding a less intensive “booster” or “maintenance” period, and the in-progress study by Saper et al. (2014) will evaluate this possibility. Examining the relative value of different formats of yoga delivery (e.g., classes, computer-assisted, DVD) is also needed to optimally integrate yoga into the care for chronic back pain patients. This will be especially important for understanding how to extend the practice of yoga for populations that might not have ready access to appropriate classes.

Studies have typically compared yoga to usual care or, less commonly, to exercise. Yet, comparative effectiveness studies comparing yoga with other forms of evidence-based care could also be valuable. While deconstructing the active ingredients of behavioral medicine interventions is a high research priority in general, the value of this when optimizing yoga for back pain is less clear. Studies of other, more technical, issues such as improving measurement of adverse events, intervention fidelity, and home practice (e.g., using technology such as wearable fitness monitors or “smart” yoga mats), are also needed.

Table 8.1 Large randomized controlled trials of yoga for chronic nonspecific low-back pain† (N = 90–31

Author	Sample	Back pain definition	Adherence	Outcome measures	Results
Last name Year (country)	**– N = (Yoga/ control)** **– Age range: X–X** **– Mean age** **– Race** **– Gender**	**– Back pain** **– Inclusion** **– Exclusion**	**– Attendance** **– Adherence definition and %**	**– Assessment** **– List * primary and secondary outcome variables**	*****p < .001** ****p < .01** ***p < .05** **(trend) ^p < .**
Aboagye et al., 2015 (Sweden)	– N = 159 (Yoga = 52; Exercise therapy = 52; Self-care advice = 55) – Age range: NR – Mean age: 46.9 – Race: NR – 72% female	– Nonspecific LBP – Duration of back pain NR – Score > 90 on OMPSQ – Sickness absences < 8 weeks in last year – Fluent Swedish	– Attendance: NR – Adherence defined as practicing 2 or more times per wk reported via text message – 54% adhered to training recommendation (≥ 2 ×/w)	– Wk 6, Mo 6, 12 – Pain: NR – Disability: NR – *HRQL: EQ–D – *Cost-effectiveness (societal & employer perspectives) using EQ–5D, derived QALYs and costs – Generic disability: # days of sick work absences in last year – Safety: NR	– HRQL: For adherent pati only, yoga superior to se care* but not exercise – CEA – Mean societal cost £1,519 & £2,124 more exercise and s care, respectively, t yoga – Mean employ cost of yoga is £150 greater self-care and £206 less tha exercise. Incremental c effectiveness ratio for yoga £4,984 – Mean days of work absence yoga (12.4), exercise (22.4 advice (29.6)
Saper et al., 2013 (US)	– N = 95 (Yoga 1 class/wk = 49; yoga 2 classes/wk = 46) – Age range: 20–64 – Mean age: 47.5 – 82% non-white – 76% female	– Nonspecific LBP – Persisting ≥ 12 wk – Average intensity ≥ 4 for previous wk on 0–10 numerical rating scale	– Median # of classes attended: 8.2 for 1 ×/wk and 12.7 for 2 ×/wk – Adherence defined a priori as attending > 75% of classes – 1 ×/wk: 32 (65%) – 2 ×/wk: 20 (44%)	– Wk 6, 12 – *Pain: 11-pt NRS – *Disability: modified RMDQ – HRQL: SF-36 – Pain medication use – Safety: # of AEs	– Pain, RMDQ, p medication, a SF-36 PCS improved with both groups a wk*** – Sf-36 MCS improved with class/wk** – NSD, 1 class/ vs. 2 classes/ at wk 12: – Pain [−2.1 (95 CI −2.9, −1.3 −2.4 (95% CI −3.1, −1.8), p 0.62]

					– RMDQ [−5.1 (95% CI −7.0, −3.2) vs. −4.9 (95% CI −6.5, 3.3), $p = 0.83$ – SF-36 PCS [6. (95% CI 3.6, 9 vs. 6.3 (95% C 4.1, 8.4), $p =$ 0.93] – SF-36 MCS [4 (95% CI 1.3, 6 vs. 2.5 (−0.7 5.7), $p = 0.47$ – Use of any pa medication AEs: 1 class/wk 13; 2 classes/w 17; 1 serious AE (cervical radiculopathy)
Sherman et al., 2005 (US)	– $N = 101$ (Yoga = 36; Exercise class = 35; Book = 30) – Age range: 20–64 – Mean age: 44 – 80% white – 66% female	– Nonspecific LBP – Persisting ≥ 12 wk – Symptom bothersomeness ≥ 3 on 0–10 NRS	– All participants attended at least one class; 25% attended 5 or fewer classes; 64% attended 9 or more classes – Median # of classes attended: 9 – 75% of yoga group reported home practice at least 3 ×/wk at 12 wk – Adherence not explicitly defined	– Wk 6, 12, 26 – *Symptom bothersomeness: 11-pt scale – *Disability: modified RMDQ – HRQL: SF-36 – Generic disability: # days of restricted activity – Pain medication use – Safety: # of AEs	– Yoga > Book – Bothersome scale – 12 wk: NSD – 26 wk: −2.2 (CI, −3.2 to −1.2)*** – RMDQ – 12 wk: −3.4 (95% CI, −5 −1.6)*** – 26 wk: −3.6 (95% CI, −5 −1.8)*** Yoga > Exercise class – Bothersomene scale – 12 or 26 wk NSD – RMDQ – 12 wk: −1.8 (95% CI, −3 − 0.1)* – 26 wk: NSD NSD, Yoga vs. B or Exercise clas – SF-36 at 12 or wk – # days of restricted acti AEs: Yoga = 1; Exercise = 1
Sherman et al., 2011 (US)	– $N = 228$ (Yoga = 92; Stretchin	– Nonspecific LBP – Persisting ≥ 12 wk – Symptom bothersomeness	– 65% attended ≥ 8 yoga classes – 67% attended ≥ 3 of the first 6	– Wk 6, 12, 26 – *Symptom bothersomeness: 11-pt NRS	Yoga > Book: – Bothersomene scale – 12 wk: −1.1 (95% CI, −1

	g class = 91; Book = 45) – Age range: 20–64 – Mean age: 48.4 – 87% white – 64% female	≥ 3 on 0–10 NRS	classes and ≥ 3 of the last 6 classes – 63% of the attendees reported home practice 3 or more days per wk – Adherence not explicitly defined	– *Disability: RMDQ – Generic disability: # days of restricted activity – Patient satisfaction – Global improvement – Safety: # of AEs	−0.4)*** – 26 wk: NSD – RMDQ – 12 wk: −2.5 (95% CI, −3 −1.3)*** – 26 wk: −1.8 (95% CI, −3 −0.5)*** – Global improvement 12 and 26 wk – Patient Satisfaction a wk Yoga vs. Stretch class: – NSD at 12 or wk: Pain, RMD – Yoga > Stretc at 12 wk: Pati Satisfaction – Global improvement 12 and 26 wk AEs: Yoga = 14 Exercise = 13; Book = 1; 1 ser AE (disc herniat
Tilbrook et al., 2011 (UK)	– *N* = 313 (yoga = 156; UC = 157) – Age range: 18–65 – Mean age: 46.3 – Race: NR – 70% female	– Nonspecific LBP – Recruited from 20 general practices; consultation for LBP within last 18 mo – Score > 4 on RMDQ	– 60% attended > 3 of the first 6 sessions and > 3 other sessions. – Home practice in yoga group was reported at mo 3 (82%), 6 (65%) and 12 (60%) – Adherence not explicitly defined	– Mo 3, 6, 12 – Pain: ABPS – *Disability: RMDQ – HRQL: SF-12, EQ-5D – Self-efficacy: PSEQ – Safety: # of AEs	Yoga > UC: – RMDQ: – 3 mo: −2.17 (95% CI, −1 to −3.31)*** – 6 mo: −1.48 (95% CI, −0 to −2.62)* – 12 mo: −1.5 (95% CI, −0 to −2.71)** – PSEQ at 3 and Mo* – NSD, Yoga vs. – ABPS at 3, 6 a 12 mo – SF-12, EQ-5D 3, 6 and 12 m – PSEQ at 12 m AEs: Yoga = 12 = 2; 1 serious A (severe pain)
Williams et al., 2009 (US)	– *N* = 90 (Yoga = 43; WLC = 47) – Age range: 23–66 – Mean age: 48	– Nonspecific LBP – Persisting ≥ 3 mo – ODI score 10-60 and VAS score 3–8 cm	– 72% completed the 24-wk class protocol – Adherence not explicitly defined	– Wk 12, 24, 48 – *Pain: VAS – *Disability: ODI – *Depression: BDI-II – *Medication use – Safety: # of AEs	Yoga > WLC at wk: – ODI (29% reduction)** – VAS (42% reduction)** – BDI-II (45.7% reduction)***

	– 93.3% white – 76.7% female	NSD, Yoga vs. W at 24 wk: – Medication us AEs: Yoga = 0; = 0

†Chronic Nonspecific Low-Back Pain – typically defined as pain in the lumbosacral area lasting 12 weeks or longer that cannot be clearly explained by any identifiable pathology on physical exam or diagnostic testing (e.g., spinal canal stenosis, large herniated disc, ankylosing spondylitis, fracture, osteomyelitis, epidural abscess, malignancy).

ABPS: Aberdeen Back Pain Scale; AE: adverse event; BDI-II: Beck Depression Inventory, 2nd ed; CI: 95% Confidence Intervals; cm: centimeters; EQ-5D: European Health Related Quality of Life Questionnaire; HRQL: Health-related Quality of Life; LBP: low-back pain; mo: months; NR: not reported; NRS: numerical rating scale; NSD: no significant difference; ODI: Oswestry Disability Index; OMPSQ: Orebo Musculoskeletal Pain Screening Questionnaire; PSEQ: Perceived Self-Efficacy Questionnaire; RMDQ: Roland Morris Disability Questionnaire; SF-12: Medical Short Form-12; SF-36: Medical Short Form-36; SF-36 PCS: SF-36 Physical Component Summary; SF-36 MCS: SF-36 Mental Component Summary; UC: Usual care; VAS: – Visual Analog Scale; wk: week; WLC: waitlist control.

Table 8.2 Small randomized controlled trials of yoga for chronic nonspecific low-back pain† (*N* = 12–80)					
Author	**Sample**	**Back pain definition**	**Adherence**	**Outcome measures**	**Results**
Last name Year (country)	**– *N* = (Yoga/control) – Age range: X-X – Mean age – Race – Gender**	**– Back pain – Inclusion – exclusion**	**– Attendance – Adherence definition and %**	**– Assessment frequency – List * primary and secondary outcome variables**	******p* < .001 ***p* < .01 **p* < .05 (trend) ^*p* < .10**
Attanayake et al., 2010 (India)	– *N* = 12 (Yoga + YLS = 6; YLS only = 6) – Age range: 30–49 – Mean age: NR – 82% non-white – 76% female	– Nonspecific LBP – Persisting ≥ 3 wk – Exclusion if specific cause of LBP, neurologic symptoms, or concomitant illness	– 12 (100%) attended entire residential program	– Wk 3 – Pain: 5-point numerical scale – Generic disability: pain frequency, sleep, personal care, travel, work, recreation, lifting, walking, standing – Safety: NR	– Yoga + YLS > YLS at 3 wk: – Pain intensity**, pain frequency** – Personal care**, travel**, recreation**, lifting** and standing** – NSD, Yoga + YLS vs. YLS at 3 wk: – Sleep, work & walking
Cox et al., 2010 (UK)	– *N* = 20 (Yoga = 10; UC = 10) – Age range: 18–65 – Mean age: 45 – Race: NR – 65% female	– Nonspecific LBP – Persisting > 3 mo – RMDQ > 4	– Half of participants attended 0 yoga sessions – Half attended 2–5 sessions – Adherence not explicitly defined	– Wk 12 – Pain (ABPS) – *Disability: RMDQ – HRQL: SF-12 EQ-5D – # of days in bed; # of days with restricted activities – Pain medication use – Safety: NR	– NSD, Yoga vs. UC at 12 wk: – Pain reduction – RMDQ – SF-32, EQ-5D – # of days in bed – # of days with restricted activities – Pain medication use
Galantino et al., 2004 (US)	– N = 22 (Yoga = 11; WLC = 11) – Age range: 30–65 – Mean age: 44 – Race: NR – 77% female	– Nonspecific LBP – Persisting > 6 mo – Minimum of 2 conservative treatments without long-term relief	– Attendance NR – Adherence not explicitly defined	– Wk 6 – *Disability: ODI – *Depression: BDI – *Functional measures: FR, SR – Safety: NR	– Yoga > WLC at 6 wk: – BDI^ – NSD, Yoga vs. WLC at 6 wk: – ODI, FR & SR
Saper et al., 2009 (US)	– *N* = 30 (Yoga = 15; Self-care book = 15) – Age range: NR – Mean age: 44 – 24% white	– Nonspecific LBP – Persisting ≥ 12 wks – Mean pain intensity > 4	– Attendance: median of 8 classes; range 8 10 classes	– Wk 12 – *Disability: modified RMDQ – *Pain Score: 11-point NRS	– Yoga > Book at 12 wk: – Pain reduction* – Global improvement*

	– 70% black – 83% female	on 0–10 NRS – No back surgery within the last 3 years	– Adherence not explicitly defined	– HRQL: SF-36 – Global improvement: 7-point scale – Pain medication use – Safety: # of AEs	– Decreased pain medication use* – NSD, Yoga vs. Book at 12 wk: – RMDQ, SF-36 – AEs: Yoga = 1; Book = 0
Tekur et al., 2008, 2010, 2012 (India)	– *N* = 80 (Yoga = 40; Exercise = 40) – Age range: 18–60 – Mean age: Yoga = 49 Exercise = 48 – 0% white – 45% female	– Nonspecific LBP – Patients with or without pain to the legs included – Persisting > 3 mo	– 40 (100%) attended entire residential program	– Wk 1 – Disability: ODI – Pain: 11-point NRS – HRQL: WHO-QOL-BREF – Depression: BDI – Anxiety: STAI – Functional Measures: spinal flexion, extension, RLF, LLF and SLR – Safety: # of AEs	– Yoga > Exercise at 1 wk: – ODI** – Pain*** – WHO-QOL-BREF** – BDI*** – State anxiety***, trait anxiety*** – Flexion**, extension**, RLF^, LLF** SLR*** – AEs: Yoga = 0; Exercise = 0
Williams et al., 2005 (US)	– *N* = 60 (Yoga = 30; Education = 30) – Age range: NR – Mean age: 48 – 91% white – 65% female	– Nonspecific LBP – Persisting > 3mo	– 20 (67%) completed 16 wk yoga intervention – Completers achieved a 92% attendance rate – Adherence not explicitly defined	– Wk 16, 28 – *Disability: PDI – Pain: VAS; PPI – Pain medication use – Safety: # of AEs	– Yoga > Education – PDI** and VAS* at wk 28 – PPI* at wk 16 and 28 – Pain medication use at wk 18 and 28** – NSD, Yoga vs. Education – PDI and VAS at wk 16 – AEs: Yoga = 1; Education = 0

†Chronic Nonspecific Low-Back Pain – typically defined as pain in the lumbosacral area lasting 12 weeks or longer that cannot be clearly explained by any identifiable pathology on physical exam or diagnostic testing (e.g., spinal canal stenosis, large herniated disc, ankylosing spondylitis, fracture, osteomyelitis, epidural abscess, malignancy).

AE: adverse event; BDI: Beck Depression Inventory Questionnaires; Book: usual care + educational book; EQ-5D: European Health Related Quality of Life Questionnaire; FR: forward reach test; HRQL: health-related quality of life; LBP: low-back pain; LLF: left lateral flexion; NR: not reported; NRS: numerical rating scale; NSD: no significant difference; ODI: Oswestry Disability Index; PDI: Pain Disability Index; PPI: Present Pain Index; RLF: right lateral flex ion; RMDQ: Roland Morris Disability Questionnaire; SLR: straight-leg raise ; SR: sit and reach test; SF-36: Medical Short Form-36; STAI: State-Trait Anxiety Inventory; UC: usual care; VAS: visual analog scale; WHO-QOL-BREF: World Health Organization Quality of Life assessment, abbreviated version; WLC: waitlist control; YLS: yoga lifestyle.

Table 8.3 Yoga protocol details of published and ongoing low-back pain randomized controlled trials

Last name Year (country)	S: Style of yoga I: Intervention components	D: Dose F: Frequency HP: Home practice	I: # of yoga instructors Q: Instructor qualifications C: Back-pain-specific yoga training	Reporting on a) specific class sequences; b) modifications; c) progression; d) measurement of fidelity
Aboagye et al., 2014 (Sweden)	S: Kundalini I: Asanas1	D: 6 wk F: 2 classes/wk HP: Encouraged daily during study period and at least 2 ×/wk thereafter; facilitated by CD and manual	I: 1 Q: International diploma in Medical Yoga & Meditation. “Medical Yoga instructor” for medical yoga in Sweden. C: The instructor qualified in medical yoga, including back pain	a) NR b) NR c) NR d) NR
Attanayake et al., 2010 (India)	S: Not named I: Asanas, pranayama,2 prayer, chanting, lifestyle	D: 3 wk F: Daily practice (60 min) at intensive residential program HP: NA	I: NR Q: NR C: NR	a) Specific class sequences for wk 1, 2 and 3 b) NR c) Sequences increased in difficulty each wk d) NR
Cox et al., 2010 (UK)	S: Hatha (with Iyengar influence) I: Asanas, pranayama, dharana,3 relaxation, philosophy	D: 12 wk F: 1 class/wk (75 min) HP: Encouraged by providing yoga supplies, manual, and weekly handouts	I: 1 Q: BWY4 certified instructor C: Trained in protocol, provided with manual	a) Protocol developed by Iyengar teacher, LBP yoga specialist, in collaboration with trial instructor b) Modifications were made available to participants when needed c) Yoga class gentle and progressive over 12 wk; class 1 focused on pain-relieving asanas; classes 2–6 introduced fundamental yoga poses; classes 7–12 progressed in difficulty d) NR
Galantino et al., 2004 (US)	S: Hatha I: Asanas, pranayama, relaxation, meditation, yamas,5 niyamas6	D: 6 wk F: 2 classes/wk (60 min) HP: Encouraged daily (60 min)	I: 1 Q: Yoga Alliance registration7 C: NR	a) Protocol developed by expert panel of two senior hatha instructors and a physical therapist; general class flow outlined with list of specific asanas and sequences b) Adapted to individuals to prevent injury: feedback provided by instructor to

				safely and effectively perform asanas and breathing techniques c) NR d) NR
Groessl et al., 2015 (US)	S: Hatha (with Iyengar and viniyoga influences) I: Asanas, pranayama, meditation	D: 12 wk F: 2 classes/wk HP: encouraged with aid of manual	I: 1 Q: Yoga Alliance registration C: Assisted in developing intervention, VA clinical yoga for CLBP program instructor	a) Each session began with meditation and breathing; 23 main poses (32 variations) with breath b) Modifications are reviewed by instructor for almost all poses; some tailoring to individual ability c) Progressively more challenging d) 25% of sessions are videotaped to assess instructor fidelity to intervention
Jacobs et al., 2004 (US)	S: Iyengar I: Asanas, pranayama, relaxation	D: 12 wk F: 2 classes/wk (90 min) HP: 5 ×/wk (30 min) by providing supplies and illustrated pamphlet	I: 4 Q: Iyengar certification; > 10 years of teaching experience C: Experience with CLBP patients	a) Protocol developed by 8 senior Iyengar instructors, recognized nationally and internationally; 28 asanas were selected including mandatory poses for daily practice b) Discussed modifications for many of the mandatory and optional poses c) Progressions were described for various poses d) NR
Saper et al., 2009 (US)	S: Hatha I: Asanas, pranayama, relaxation	D: 12 wk F: 1 class/wk (75 min) HP: encourage daily (30 min) by providing supplies, CD, and manual	I: 2 Q: Yoga Alliance registration; > 4 years of teaching experience; experience teaching undeserved populations C: Instructors trained in protocol	a) Protocol developed by expert panel informed by literature review and non-peer-reviewed resources; classes were divided into four 3-wk sections b) Modifications and props used c) Each of the 4 segments built upon the previous d) Direct observation of several classes by yoga experts
Saper et al., 2013 (US)	S: Hatha I: Asanas, pranayama, relaxation, philosophy	D: 12 wk F: 1 class/wk (75 min) vs. 2 classes/wk (75 min) HP: Encouraged daily (30 min) by providing supplies, CD and manual;	I: 7 Q: > 200-hr Yoga Alliance registration and > 2 years teaching experience C: In-person training and detailed manual	a) Classes were divided into four 3-wk sections b) Modifications included predetermined variations of protocol poses and use of props c) Protocols progressed in difficulty with each ensuing section d) Observed 10% of classes and assessed for fidelity using a checklist

		tracked with home practice log		
Saper et al., 2014 (US)	S: Hatha I: Asanas, pranayama, relaxation, philosophy	D: 12 wk F: 1 class/wk (75 min) HP: Encouraged daily (30 min) by providing supplies, DVD, and manual; tracked with home practice log	I: 11 Q: > 200-hr Yoga Alliance Registration and > 2 years teaching experience C: In person training and detailed manual	a) Adapted from Saper (2013) b) Modifications included predetermined variations of protocol poses and use of props c) Protocols progressed in difficulty with each ensuing section d) Observed 10% of classes and assessed for fidelity using a checklist
Saper et al., 2015 (US)	S: Hatha I: Asanas, pranayama, relaxation, philosophy	D: 12 wk F: 1 class/wk (75-min) HP: Encouraged daily (30 min) by providing supplies, DVD, and manual; tracked with home-practice log	I: 4 Q: > 200-hr Yoga Alliance registration, Warriors at Ease8 training, and > 2 years teaching experience C: In-person training and detailed manual	a) Adapted from Saper, 2014 b) Modifications included predetermined variations of protocol poses and use of props c) Protocols progressed in difficulty with each ensuing section d) Observed 10% of classes and assessed for fidelity using a checklist
Sherman et al., 2005 (US)	S: Viniyoga I: Asanas, pranayama, relaxation	D: 12 wk F: 1 class/wk (75 min) HP: Encouraged daily (20 min) with handouts and CDs; tracked with home-practice log	I: 1 Q: Senior viniyoga teacher C: Developed the protocol and experienced teaching students with back pain	a) Protocol developed by two senior viniyoga teachers; designed for participants new to yoga; included 17 simple asanas. Each class included 5-12 asanas that were not held but repeated 3 or 6 times b) Modifications, variations, and adaptions of poses available c) Six distinct and progressive pairs of classes d) Instructor developed protocol and was in weekly contact with research team
Sherman et al., 2011 (US)	S: Viniyoga I: Asanas, pranayama, relaxation	D: 12 wk F: 1 class/wk (75 min) HP: Encouraged daily (20 min) with handouts and CDs; tracked with home-practice log	I: 6 Q: Certified viniyoga teacher; > 500 hours of training and > 5 years of experience C: Detailed manual and in-person training	a) Sherman, 2005 protocol was used for this larger trial b) Modifications, variations, and adaptions of poses were available for participants c) Six distinct and progressive classes taught in pairs d) Researcher observed 1 class per cohort

			by developer of yoga protocol	
Tekur et al., 2008, 2010, 2012 (India)	S: VYASA9 I: Asanas, pranayama, relaxation, meditation, chanting, counseling, lectures, lifestyle, mind-sound-resonance technique	D: 1 wk F: Daily practice at intensive residential program HP: Encouraged beyond study period by video	I: NR Q: NR C: NR	a) IAYT multimodal approach, intensive residential protocol, including 15 yoga asanas identified in Sanskrit and English. b) Modifications incorporated throughout; asanas tailored to individual by yoga therapist c) Gentle movements in the morning, asanas progressed to achieve therapeutic effect; guided by yoga therapist d) NR
Tilbrook et al., 2011 (UK)	S: Hatha (with Iyengar influence) I: Asanas, pranayama, relaxation, mental focus, meditation, philosophy, lifestyle	D: 12 wk F: 1 class/wk (75 min) HP: Encouraged daily by providing supplies, relaxation CD, and instruction manual	I: 20 Q: Certified Iyengar (*N* = 10) or BWY (*N* = 10) instructors C: LBP protocol training sessions over 2 weekends	a) Protocol developed by panel of expert Iyengar and BWY practitioners b) Modifications were made available to participants when needed c) Weekly progressions designed to increase confidence in performing more daily activities. d) Observed at each site on two separate occasions
Williams et al., 2005 (US)	S: Iyengar I: Asanas, pranayama, relaxation	D: 16 wk F: 1 class/wk (90 min) HP: Encouraged 5 ×/wk (30 min)	I: 2 (with 4 assistants) Q: > 10 years personal training in Iyengar yoga; > 8 teaching experience C: Experience teaching participants with CLBP	a) Protocol developed by senior Iyengar instructors and consisted of 29 asanas; back bends were avoided b) Modifications and an extensive variety of props were available c) Gradual progression of increasing difficulty d) NR
Williiams et al., 2009 (US)	I: Iyengar: S: Asanas, pranayama, relaxation	D: 24 wk F: 2 classes/wk (90 min) HP: Encouraged 5 ×/wk (30 min) by providing supplies, DVD, and instruction manual	I: 1 (with 2 assistants) Q: Certified Iyengar instructor C: Experience teaching participants with CLBP	a) Developed by senior instructors and included 31 asanas; approved by B. K. S. Iyengar b) Protocol lists specific predetermined modifications and an extensive variety of props were available c) Gradual progression of increasing difficulty d) NR

1Asanas = yoga postures
2Pranayama = yogic breathing exercises
3Dharana = meditation
4BWY = British Wheel of Yoga; http://www.bwy.org.uk
5Yamas = yogic attitudes and behaviors

6Nyamas = yogic attitudes and behaviors
7Yoga Alliance = www.yogaalliance.org
8Warriors at Ease = www.warriorsatease.org
9VYASA = Vivekananda Yoga Anusandhana Samsthana.
CLBP: chronic low back pain; IAYT: Integrated Approach to Yoga Therapy; min: minutes; NA: not applicable; NR: not reported; wk: week.

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Back conditions: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Anukool Deval finds that often, “Back pain starts with poor postural habits and a lack of awareness.” Similarly, Tom Alden commonly sees “an overemphasis on doing and an under appreciation of awareness, understanding, and attitude in action.” To overcome back pain, Alden says, “The person needs to develop awareness of his or her blind areas when doing yoga,” which he refers to as *vipassana* [literally, “clear seeing”] in *asana* . “With increased understanding, attitudes and actions can be modified.”

Judith Hanson Lasater stresses the importance of “postural re-education” in those with back pain, and her go-to pose for students is often *tadasana* (mountain pose). “Teaching the student to sit and stand with the normal curves in the vertebral column does wonders for taking the strain off surrounding soft tissues. Most students greatly underestimate the amount of curve that is ‘normal’ in the lumbar spine.”

Deval suggests, beyond asana, to “focus on correction of posture while standing, sitting—on the ground or on a chair—and walking.” He says the “choice of postures and their sequence depends on the type, severity, and location of the pain." In general, he advises to avoid jerky or fast movements during asanas and to breathe deeply. "Simple breathing techniques help to relax the muscles throughout the body, including those in the back," he says.

Julie Gudmestad varies her approach depending on the apparent mechanism of the back pain. While some people get pain because they tend to flatten the lumbar spine, in others she finds hyperextension of the lumbar spine (sway back), each requiring very different practices to address the underlying cause. What works for these students, in turn, may not be successful in those with pain due to a hyperkyphotic thoracic spine (and forward head position). This latter problem, she says is "often a result of prolonged slumped sitting and/or work or recreational activities with arms forward (cycling, driving, keyboard work). It is usually accompanied by shallow breathing, because the diaphragm is compressed, and may be associated with depression or fatigue. Muscle imbalances include short, tight chest and anterior neck muscles (pectoralis major and minor, sternocleidomastoid), short upper abdominals, and weak mid-back muscles (erector spinae and mid and lower trapezius)."

Gudemestad's approach to hyperkyphosis involves using mild supported backbends to open the chest and soften the upper abdomen and active backbends to strengthen back muscles. In addition, she works to "improve ribcage mobility and re-educate breathing patterns, including normal diaphragmatic breathing." *Salabasana* (locust pose), she says, "is a great pose for strengthening the mid-back muscles. To avoid lumbar hyperextension, lift the head and chest only a few inches, and focus on opening the chest by moving the shoulders away from the floor and away from the ears. Look at the floor to help maintain a normal neck curve."

According to Robin Monro, herniated lumbar disks often heal spontaneously. Those that get worse, however, can lead to long-term disability. He believes it is essential to employ yoga practices that do not risk an exacerbation of the disk herniation. The primary practices he recommends are done lying on the floor, either prone or supine, which causes less loading on the spine than either seated or standing poses. As the student improves, other poses may be added.

Monro typically begins with the student lying in savasana, with support under the knees as needed, to relax and cultivate awareness. Then lying supine with knees bent, the student places his or her hands on the knees and moves the knees in small circles, first in one direction then the other, which, he says, "massages and loosens the lumbar and sacral regions." Next, the student brings the knees in closer to the chest, holding the legs with the arms wrapped around the shins. From there, the student begins to gently roll the body from side to side, at first just a little, then gradually increasing how far down he or she goes. "The goal," says Monro, "is to go all the way down on each side and to come up without using the elbows to help. But until the abdominal muscles are strong enough, and there is sufficient control to come up without using the elbows, the student should roll only to the point where the legs are about to fall to the floor, or go all the way to the floor, and come up by raising the upper leg first."

Lasater notes that some people with low-back pain appear to somaticize life stressors, "using back pain as a way to avoid emotional pain. This emotional repression can be tied to poor sitting and standing posture and too much tucking the tailbone as a way of ‘holding on and holding in’ this emotional pain.” She finds that the low-back pain “often resolves when the emotional pain is dealt with. Sometimes diagnostic tests shows little and pain is great.”

Lasater has had good luck in relieving back pain originating in the sacroiliac joint by encouraging her students to “move the pelvis with the spine in forward bends and twists.” When twisting to the right, for example, the student should allow the pelvic bones to also turn slightly to the right, rather than keeping them in place, as is often taught. This same advice can be applied to “the activities of daily living that include, especially, twisting and lifting.”

In developing therapeutic yoga routines for students with back pain due to scoliosis, Eliana Moreira considers more than just the location and severity of the abnormal spinal curves. For example, many students with scoliosis also show an increase in the ayurvedic *vata dosha* and often respond to grounding and quieting practices. In addition, she very commonly finds that these students have sensitive nervous systems and get easily frustrated. “If you take a purely structural approach to trying to reduce their curves,” she says, “you may choose practices that are biomechanically sound, but which exacerbate their vata derangement or leave them agitated or unsettled.”

Probably the most valuable practice Moreira has found for scoliosis (and for back pain in general) is a *supta tadasana* (supine mountain pose) a variation called “wedging.” Moreira says, “In wedging, the student starts out lying on a sticky mat placed adjacent to a wall. With the knees bent and balls of the feet just touching the wall, the student slowly slides the heels toward the wall to come into the pose” (see Fig. 8.1 A–C). The tackiness of the sticky mat allows for traction along the spine and improves proprioceptive awareness of skin, muscles, and bones. From the feet up, the whole body finds balance and alignment. “Try not to adjust yourself along the way,” she cautions students, “or you’ll lose traction. If necessary, arrange your clothing before you start, to prevent it from bunching up or starting to choke you.”

It typically takes students several attempts before they get the feel of wedging, but “once they have it,” Moreira says, “they’ll be able to do it every time.” One caveat: it’s vital that students set themselves up as symmetrically as possible before they begin to push off the wall. If there is a leg-length discrepancy or the pelvis is higher on one side, Moreira may place a prop, as shown in Figure 8.1 A–C, between the wall and the foot of the shorter leg. She instructs: “By starting out well-aligned with the feet hip-distance apart and the knees, hips, and shoulders in a line, as you press your feet into the wall, your body starts to learn what a more balanced alignment feels like.” She uses the word “balanced” intentionally, because she has found that many students with scoliosis feel self-conscious about their spines and have an emotional response to words like “straight” and “crooked.”

Moreira finds it’s vital to not flatten either the cervical or lumbar curves when pushing into the pose. She recommends stopping short of fully straightening the legs, because many students have a tendency to lock their knees. She suggests that students stay in the wedging position for a minute or longer and then stand up and try a traditional tadasana, which may feel different—and better—than it did before.

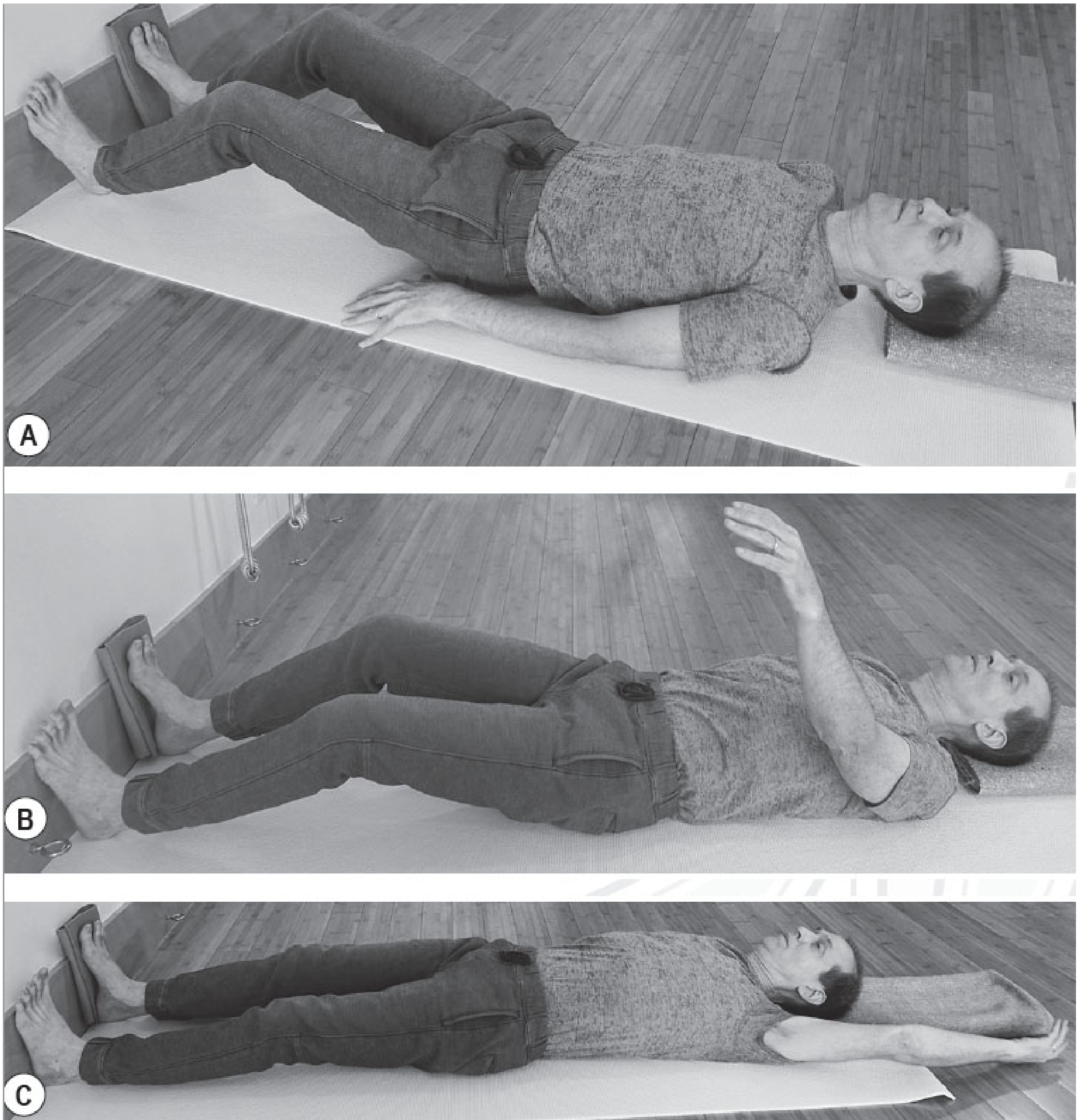

Figure 8.1 A– C

Wedging into supine mountain pose is useful for many types of back pain as well as for scoliosis. In this example, a student with a right thoracic curve is using a folded mat piece beneath his right foot to balance his hips and lifting his left arm as he comes into the pose to increase opening of the left side of the rib cage.

Photographs by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Resources

Book: *Yogabody: Anatomy, Kinesiology, and Asana* by Judith Hanson Lasater

Book: *Yoga as Medicine* by Timothy McCall (chapter on back pain features Judith Hanson Lasater's approach)

Book: *Yoga for Back Pain* by Loren Fishman and Carol Ardman

Book: *Yoga for a Healthy Lower Back* by Liz Owen and Holly Lebowitz Rossi

Article: "Serial Case Reporting for Idiopathic and Degenerative Scoliosis," Loren Fishman, Karen Sherman, Eric Groessl. *Global Advances in Health and Medicine,* September 2014, Vol. 3, No. 5: pp. 16–21.

CHAPTER NINE

YOGA THERAPY FOR MUSCULOSKELETAL AND NEUROMUSCULAR CONDITIONS

H CRAMER • SH MOONAZ • SJ BARTLETT

Introduction

Worldwide, musculoskeletal (MSK) disorders are the second leading cause of disability. Rates of disability due to MSK disorders rose an estimated 45% from 1990 to 2010 (Vos et al., 2012). With a lifetime prevalence of about 50%, neck pain represents the most common MSK disorder after low-back pain, and ranks fourth worldwide in terms of overall disability (Fejer, Ohm Kyvik, & Hartvigsen, 2006; Hoy et al., 2014). Arthritis, which affects one in five adults in the United States, or more than 52.5 million adults, is a chronic, painful condition that remains the most common cause of disability (Centers for Disease Control and Prevention, 2013). Although the term *arthritis* is often used to describe more than 100 conditions affecting the joints, surrounding tissues, and other connective tissues, this chapter focuses on the two most common forms of arthritis: osteoarthritis (OA) and rheumatoid arthritis (RA). Carpal tunnel syndrome (CTS), a condition causing pain, numbness, and burning or tingling in the hand and fingers, affects 3% to 5% of adults (NHS, 2014). The disability associated with neck pain, arthritis, and CTS result in substantial economic costs and impairments in health-related quality of life (HRQOL).

Chronic neck pain is defined as persistent or recurring pain in the neck and shoulder area. Although there are numerous conditions that can cause or aggravate neck pain, serious pathologies are involved in less than 0.5% of neck pain patients (Bogduk, 2003). The majority of cases are diagnosed with chronic trauma-related neck pain or with nonspecific neck pain, reflecting pain that is not associated with structural changes but mainly with environmental, work-related, and psychosocial factors (Hogg-Johnson et al., 2008). Besides pain, common symptoms include restricted range of motion, stiffness, and tenderness, resulting in increased disability in activities of daily living (ADL).

OA, also known as degenerative joint disease, affects the entire joint, including the cartilage, joint lining, ligaments, and bone. The joints affected most often include the knees, hips, hands, neck, and spine (Ling & Rudolph, 2006). Mechanical, cellular, and biochemical processes lead to abnormal repair of cartilage and increased degradation. Degeneration of cartilage, in combination with the breakdown of supportive tissues and overgrowth of bone, leads to pain and stiffness. As OA progresses, bone remodeling (osteophytes, subchrondral cysts) and edema often occur, along with inflammation of surrounding tissues. Formal diagnosis of OA is made by evaluating changes using X-rays (e.g., narrowing of joint space, presence of osteophytes) in combination with patient reports of pain, swelling, and stiffness. Major risks factors for OA include older age, joint trauma, injury, and obesity (Centers for Disease Control and Prevention, 2014a). With the growing number of overweight and obese individuals and longer lifespans in the general population, the incidence of hip and knee OA is expected to continue to escalate.

RA is an autoimmune disease associated with considerable morbidity and early mortality, characterized by high levels of systemic inflammation affecting multiple joints and organs in the body. The inflammatory process affects the lining of the joints (synovium), often causing bone and cartilage erosions, which can ultimately lead to deformities in the joint. RA is diagnosed based on the results of a physical examination and history, X-rays, and blood tests (National Institute of Arthritis and Musculoskeletal and Skin Diseases, 2014). Treatment usually involves use of disease-modifying antirheumatic drugs (DMARDs), including biologics and nonsteroidal anti-inflammatory drugs (NSAIDs); corticosteroids and analgesics are often used continuously at low doses or intermittently to treat disease flares. Major risk factors for developing RA include being female (2–3 times higher incidence), having a first-degree relative with RA, smoking, and possibly reproductive hormones and environmental exposures (Centers for Disease Control and Prevention, 2014b).

CTS is a painful progressive disorder caused by compression of the median nerve as it passes through the narrow tunnel of ligament and bones (the carpal tunnel) at the base of the hands. Symptoms can include numbness, tingling, burning, or itching in the palm of the hands, thumbs, and fingers; as the disorder progresses, muscle weakness and atrophy can result (National Institute of Neurological Disorders and Stroke, 2014). Diagnosis is made through a clinical examination of the hands, the use of specific tests (e.g., Tinel’s sign and Phalen’s maneuver), and nerve-conduction studies. Treatment usually includes rest, use of splints, NSAIDs, and exercise; severe cases may require surgery. Risks factors for CTS include being female (women are 3 times more likely to be affected), other health conditions (e.g., diabetes, RA), and strenuous repetitive work of the hands such as assembly line work (e.g., manufacturing, sewing, cleaning, meat packing) or injuries to the wrist (National Institute of Neurological Disorders and Stroke, 2014; NHS, 2014).

Rationale for the use of yoga for musculoskeletal conditions

There is strong evidence across chronic health conditions of the potential benefit of yoga for improving pain and pain-associated disability (Büssing, Ostermann, Lüdtke, & Michalsen, 2013; Cramer, Lauche, Haller, & Dobos 2013; McCall, Ward, Roberts, & Heneghan, 2013). Yoga may provide important benefits to people living with MSK and neuromuscular disorders, for several reasons. Regular physical activity is essential to optimal management of MSK disorders (American College of Rheumatology Subcommittee on Osteoarthritis Guidelines, 2000; American College of Rheumatology Subcommittee on Rheumatoid Arthritis Guidelines, 2002) and yoga is often considered as a potential intervention for its well-recognized benefits for physical health. As a physical activity, yoga can be gentle or vigorous and can emphasize different types of movements depending on the instructor’s tendencies and training, the student(s) needs and/or limitations, and the type of class. Physical benefits depend fully on the components that are included and how they are presented. Research findings from studies on yoga vary for many reasons, in part because a diverse range of interventions is tested (Haaz & Bartlett, 2011). Once the optimal style of practice is identified and students are guided in appropriate modifications and safe execution, yoga can become a low-cost, portable, comprehensive, and sustainable activity. Beyond its physical benefits, yoga is also widely considered to be an integrative mind–body practice. In this section, we present the rationale for yoga as a physical activity for MSK and neuromuscular conditions, followed by the likely opportunities for enhanced benefit associated with a comprehensive mind–body practice.

The isometric poses of yoga asanas have the potential to build strength (Patel et al., 2012)—which is particularly important around joints that have connective tissue deterioration and damage—thereby enhancing joint stability. In cases of muscular imbalance, a yoga therapist can work with individuals to target this directly and improve alignment by addressing areas of tightness and weakness. Some systemic inflammatory conditions, such as RA, can result in cachexia, or systemic muscle wasting, which may be offset through the regular practice of strengthening poses (Cooney et al., 2011).

Yoga is probably most well known in the West as a stretching activity that improves flexibility. For those with MSK and neuromuscular conditions that might be limiting the use of affected areas, inactivity often results in reduced mobility (Badley & Ansari, 2010). Slow, gentle stretching poses can help maintain the range of motion necessary for overall mobility and daily activities (Mandroukas et al., 2014). Fluid movements can also help mobilize synovial fluid, adding lubrication to affected joints.

Yoga also includes balancing poses, which can reduce the risk of falls (Sinaki, 2012). For those with a history of falling, the confidence and balance associated with regular yoga practice may diminish fears around falling (Jeter et al., 2014). Fear of falling is a modifiable risk factor associated with decline in function and greater disability (Lach & Parsons, 2013) because it often reduces willingness to engage in meaningful activities and ADL. Enhancing body awareness and muscular balance might also improve postural alignment and stability (Yasuda et al., 2012), which could reduce the effects of compression in some conditions. The sense of accomplishment fostered by engaging in a physical activity often fosters self-efficacy for a greater range of activities and ADL, and may improve overall disease management and HRQOL (Haaz & Bartlett, 2011).

Regular physical activity is also associated with improved mood and better management of mood disorders such as depression (Cooney et al., 2013), which is a common comorbidity in arthritis (Kelley & Kelley, 2014). Whereas it was once believed that exercise had to be at least moderate in intensity to bolster mood, growing evidence suggests that even low-intensity activities reduce depressive symptoms (Mammen & Faulkner, 2013).

Beyond physical activity, yoga also offers important mind–body benefits. Yoga’s translation as “union” can be interpreted in many ways, one of which is in the coordination of breath and movement. Asanas are often accompanied by intentional breathing practices, such as full deep breathing, that stimulate the parasympathetic nervous system (Bhimani et al., 2011; Sinha et al., 2013) and can help break the stress–pain cycle involved in chronic pain conditions. For conditions with an autoimmune component, the mind–body practice of yoga may also enhance immune regulation and reduce inflammatory activity (Morgan et al., 2014; Moonaz, Bingham, III, Wissow, & Bartlett, 2015). Deep-breathing practices and progressive relaxation can also facilitate the release of muscle tension and counter the bracing that often occurs around vulnerable joints (Vallath, 2010). As demonstrated with commonly taught childbirth practices, intentional breathing and relaxation can play an important role in pain management (Kamalifard et al., 2012). In addition, those living with chronic pain often experience problems with sleep, which may be improved with practices such as breath control, relaxation, and yoga nidra (yogic sleep) (Kozasa et al., 2010). There is evidence that yoga can help improve emotional well-being by reducing symptoms of anxiety and depression and enhancing relaxation and stress management (Bartlett, Moonaz, Mill, Bernatsky, & Bingham, III, 2013; Haaz & Bartlett, 2011; Cabral, Meyer & Ames, 2011; Cramer, Lauche, Langhorst & Dobos, 2013d; 2013e).

Yoga practice also often includes meditation, mindfulness, and attention to self-inquiry. For those living with chronic, painful conditions, this may lead to redefining priorities; changing lifestyle habits, roles, and daily choices; reframing the meaning of the chronic conditions; and nurturing the relationship between body and self. Even when the process and/or symptoms of a condition cannot be altered, changes in perspective can improve coping and HRQOL. Below, we summarize the current evidence on effectiveness and safety of yoga for people with chronic neck pain, OA and RA, and CTS.

Review of the research evidence

Chronic neck pain

Yoga's therapeutic potential for improving chronic neck pain has been formally investigated in four studies. Three of those trials included participants with nonspecific neck pain, that is, individuals whose neck pain could not be attributed to specific, underlying organic causes (Cramer et al., 2013c; Michalsen et al., 2012; Yogitha, Nagarathna, John, & Nagendra, 2010). Sample sizes ranged from 51 to 77. The fourth trial included eight participants diagnosed with myofascial pain syndrome of the neck (Sharan, Manjula, Urmi, & Ajeesh, 2014). Two of the trials were conducted in India while the other two originated in Germany. Ranging from 42 to 48 years, mean age was comparable in three trials (Cramer et al., 2013c; Michalsen et al., 2012, Yogitha et al., 2010), while the myofascial pain syndrome trial included a younger sample (mean age 25 years; Sharan et al., 2014). Notably, 47% of participants were female in the Yogitha et al. (2010) trial compared to 82–87% in the German trials (Cramer et al., 2013c, Michalsen et al., 2012) (see Table 9.1 , p. 171).

Two of the trials on nonspecific neck pain used randomized controlled trial (RCT) designs and compared Iyengar yoga to a home-based exercise regimen (Cramer et al., 2013c, Michalsen et al., 2012). Yoga was practiced once weekly for 90 minutes and additional home practice was required. The intervention focused on asanas that were selected and adapted specifically for improving neck pain, and props such as blocks, blankets, and belts were used. Besides relaxation in corpse pose at the end of each session, no meditative or breathing techniques were applied. Both trials used home-based neck exercises as the control condition. The third trial on nonspecific neck pain also used an RCT design and compared 10 daily sessions of yoga-based mind sound resonance technique (MSRT) to nonguided supine rest (Yogitha et al., 2010). The MSRT comprised loud ("heard") and mental ("unheard") chanting while paying attention to the internal vibrations and resonance produced in the body. The myofascial pain syndrome trial used a 4-week hatha yoga intervention comprising 1 hour of pranayama and relaxation daily for 2 weeks; for the remaining 2 weeks, asanas were also added (Sharan et al., 2014). No control group was used (see Table 9.2 , p. 174).

All four trials reported improvements (and significant group differences in the RCTs) for neck pain intensity and neck-specific disability. All but one trial also reported improvements in cervical range of motion. Two trials assessed pressure pain thresholds using an algometer and found improved thresholds at the site of maximal pain, anatomically defined sites (Cramer et al., 2013c), or individual myofascial trigger points (Sharan et al., 2014). Additional functional tests included cervical proprioceptive acuity (Cramer et al., 2013c), grip strength, and pinch strength (Sharan et al., 2014), all of which were positively influenced by yoga. HRQOL was assessed in three trials and significant effects were evident for mental (Cramer et al., 2013c), physical (Michalsen et al., 2012), or both components of HRQOL (Sharan et al., 2014). Depression, anxiety, fatigue, and anger also improved, but vigor remained unchanged (Michalsen et al., 2012).

Two trials reported adverse events. In one trial, 11 people each in the yoga and exercise groups reported minor transient, mainly MSK, events (Cramer et al., 2013c); in the second trial, an undefined number of individuals reported minor MSK events (Michalsen et al., 2012). No serious adverse events were reported.

Only one trial included a longer-term follow-up (Cramer et al., 2013b). Although no longer using a control group design, this trial found sustained effects of yoga; 64% experienced a reduction of at least 30% in pain intensity and neck-specific disability 12 months after the intervention ended. During follow-up, no serious intervention-related adverse events were reported. Although the three RCTs on nonspecific neck pain were of moderate-to-high quality, the findings on myofascial pain syndrome are clearly limited by the small sample size and lack of a control group.

Arthritis

Representing the largest category of this chapter, 21 trials have investigated the effects of yoga on arthritis. This includes eight RCTs (Cheung, Wyman, Resnick & Savik, 2014; Evans et al., 2013; Ebnezar, Nagarathna, Bali, & Nagendra 2011; Ebnezar, Nagarathna, Yogitha, & Nagendra 2012a; Ebnezar, Nagarathna, R., Yogitha, B., & Nagendra 2012b; Ebnezar & Yogitha, 2012; Garfinkel, Schumacher, Husain, Levy, & Reshetar, 1994; Moonaz et al., 2015; Park, McCaffrey, Dunn, & Goodman, 2011; Park, McCaffrey, Newman, Cheung, & Hagen, 2014; Singh, Bhandri, & Rana, 2011) and four nonrandomized controlled trials (Badsha, Chhabra, Leibman, Mofti & Kong, 2009; Bedekar, Prabhu, A., Shyam, A., Sancheti, K., & Sancheti, 2012; Bosch, Traustadottir, Howard, & Matt, 2009; Krejci, 2011). Three trials included a control group, but it was unclear whether participants had been randomized to groups (Ghasemi, Golkar, & Marandi, 2013; Haslock, Monro, Nagarathna, Nagendra, & Raghuram, 1994; Nambi & Shah, 2013). The remaining trials were uncontrolled (Evans et al., 2010; Kolasinski et al., 2005; Park & McCaffrey, 2012; Taibi & Vitiello, 2011; Telles, Naveen, Gaur & Balkrishna, 2011; de G.R. Hansen, 2010).

In seven trials, participants had RA, mainly diagnosed using ACR (American College of Rheumatology) criteria; in five trials, knee OA was targeted, again mainly diagnosed using ACR criteria for OA. One trial evaluated the impact of yoga on hand OA and the remaining trials included mixed groups (e.g., OA of various joints, OA and RA); only one trial provided information on how the participants' diagnosis had been established. Three trials targeted specific subgroups such as people with total knee replacement (Bedekar et al., 2012), insomnia (Taibi & Vitiello, 2011), or overweight (Krejci, 2011). More than half of the trials were conducted in the United States, five were conducted in India, and two each were conducted in Europe and the Middle East. Sample sizes ranged from 8 to 250 with a median sample size of 30. Most participants (median 83%) were female. In RA, mean age ranged from 28 to 61 years with a median of 46 years, and in OA mean age ranged from 52 to 80 years with a median of 62 years (see Table 9.1 , p. 171).

The most common yoga styles were Iyengar and chair yoga. Ten trials stated either that Hatha yoga or "yoga" was used, without stating a specific yoga style. Single trials used Vishwas-Raj yoga, Integral Yoga-based yoga therapy, and the Yoga in Daily Life program. The dose varied from two sessions a day for 1 week to one session a week for 12 weeks; however, the most common schedule was one-to-two sessions a week for 6 to 8 weeks (median: two sessions over 8 weeks). Five studies included the use of props (Cheung et al., 2014; Evans et al., 2013; 2010; Kolasinski et al., 2005; Moonaz et al., 2015; Nambi & Shah, 2013) and almost all included relaxation and/or meditation, with corpse pose being the most common relaxation technique. Breathing and philosophy lectures were included less frequently. Two trials included chanting (Ebnezar et al., 2012b; Moonaz et al., 2015); one included cleansing techniques and yogic diet (Singh et al., 2011). Three trials did not include any asanas (Park & McCaffrey, 2012; Park et al., 2011; 2014), and two did not include any relaxation or meditative techniques (Bedekar et al., 2012; Taibi & Vitiello, 2011). Additional home practice was encouraged in nine trials (Bedekar et al., 2012; Cheung et al., 2014; Ebnezar et al., 2012; Evans et al., 2013; Haslock et al., 1994; Krejci, 2011; Moonaz et al., 2015; Park et al., 2011; Taibi & Vitiello, 2011). Among controlled trials, the control condition was most often usual care. Exercise, Reiki, education, and attention control were used in single trials only (see Table 9.2 , p. 174). Most encouraged participants to continue with their usual arthritis treatments.

The 21 trials used a variety of different outcomes and outcome measures (see Table 9.1 , p. 171). Pain was assessed in 16 trials; although 9 reported significant effects of yoga on pain

(Cheung et al., 2014; de G.R. Hansen, 2010; Ebnezar et al., 2012a; Evans et al., 2010; Garfinkel et al., 1994; Ghasemi et al., 2013; Kolasinski et al., 2005; Moonaz et al., 2015; Nambi & Shah, 2013), only 4 of these trials were RCTs. Six of 10 trials reported positive effects of yoga on stiffness (Bedekar et al., 2012; Cheung et al., 2014; de G.R. Hansen, 2010; Ebnezar et al., 2012b; 2012a; Nambi & Shah, 2013; Singh et al., 2011). Physical function was assessed by self-report scales in 17 trials. Twelve studies, including three RCTs, found significant effects of yoga on at least one measure of physical function (Badsha et al., 2009; Bedekar et al., 2012; Bosch et al., 2009; Ebnezar et al., 2012b; Evans et al., 2013; 2010; Ghasemi et al., 2013; Nambi & Shah, 2013; Park & McCaffrey, 2012; Park et al., 2011; Telles et al., 2011), while five found no such effects. Some trials further measured physical function and other aspects of fitness by performance tests and reported significant effects on the chair-stand test (Cheung et al., 2014), walk test (Ebnezar et al., 2011; Moonaz et al. 2015), range of motion (Wolfe et al., 2010; Moonaz et al., 2015), or grip strength (Haslock et al., 1994; Telles et al., 2011). However, others reported no change in one or more performance tests (Bosch et al., 2009; Cheung et al., 2014; Garfinkel et al., 1994; Kolasinski et al., 2005; Moonaz et al., 2015; Park et al., 2014). HRQOL was assessed in nine trials (Badsha et al., 2009; Cheung et al., 2014; Ebnezar et al., 2011; Evans et al., 2013; 2010; Ghasemi et al., 2013; Kolasinski et al., 2005; Moonaz et al., 2015; Park et al., 2014) with most trials reporting significant improvements with yoga. Three trials reported fewer depressive symptoms with yoga (Bosch et al., 2009; Park et al., 2014; Moonaz et al., 2015), while three did not (Park & McCaffrey, 2012; Park et al., 2011; Taibi & Vitiello, 2011). Changes in RA disease-activity indicators (Badsha et al., 2009; Evans et al., 2013; Moonaz et al., 2015), inflammatory markers (Badsha et al., 2009; Singh et al., 2011; Telles et al., 2011), and patient global-improvement scores (Badsha et al., 2009; Evans et al., 2013; Moonaz et al., 2015) were inconclusive, while perceived physical health (Moonaz et al., 2015), symptoms (Evans et al., 2013; 2010; Ghasemi et al., 2013), and sleep quality (Cheung et al., 2014; de G.R. Hansen, 2010; Taibi & Vitiello, 2011) improved. Two studies reported improvements in arthritis self-efficacy (Evans et al., 2013; 2010), though one did not (Moonaz et al. 2015).

Most trials did not include follow-up; however, where assessed, improvements in pain, disability, and HRQOL tended to be maintained over 2 months (Evans et al., 2013), 3 months (Ebnezar et al., 2011; 2012b; 2012a ; Ebnezar & Yogitha, 2012) or 9 months (Moonaz et al., 2015) after the intervention ended.

Again, safety-related data were inadequately reported; only four trials reported on adverse events. Kolanski et al., (2005) reported that no one experienced an adverse event. Cheung et al. (2014) and Moonaz et al. (2015) reported no yoga-related adverse events. Taibi & Vitiello (2011) reported minor yoga-related events in 8 of 13 participants (e.g., mild soreness, muscle cramps, lumbar soreness) and no serious adverse events.

Overall, most trials had major shortcomings, including lack of randomization, use of single-arm designs, and inadequate reporting of safety data. Even the positive findings of the RCTs should be interpreted with care because all but two (Ebnezar et al., 2011; Moonaz et al., 2015) failed to report use of adequate randomization procedures. Because only two RCTs reported safety-related data, inferences about the potential risk–benefit ratio of yoga for arthritis are only preliminary at this time.

Carpal tunnel syndrome

To date, only one trial has investigated the effects of yoga on CTS (Garfinkel et al., 1998). This RCT included 51 predominantly female participants with a mean age of 49 years (see Table 9.1 , p. 171). In this trial, the effects of an 8-week Iyengar yoga intervention were compared with those of using a wrist splint. The yoga intervention was offered twice weekly for 90 minutes and focused on upper body postures for improving flexibility, correcting alignment of the upper limbs, and increasing awareness of optimal joint posture. Relaxation in corpse pose was included at the end of each class; however, no further meditative or breathing practices were introduced (see Table 9.2 , p. 174). The study assessed pain intensity for the previous week as well as grip strength, the Phalen sign, the Tinel sign, and median nerve latency. While pain intensity and grip strength improved in the yoga group from before to immediately after the end of the program, significant group differences favoring yoga over the control group were found for the Phalen sign only. The findings are limited by the insufficient reporting of the study methods as well as by the lack of data on adverse events and long-term outcomes.

Summary and conclusions

Summary of evidence

A total of 26 studies focusing on categories of conditions including chronic neck pain, arthritis, and CTS were included in this chapter. Based on the few well-conducted trials, short-term improvements in pain, disability, range of motion, pain sensitivity, mood, and HRQOL were found for chronic neck pain; improvements in pain and disability persisted up to 12 months. Although studies of yoga and arthritis represented the largest category, conclusions are limited due to often-inadequate study quality. In people with RA or OA, positive effects were found for physical function, HRQOL, symptoms, and sleep. However, the evidence was inconclusive for pain, stiffness, physical function, mood, and RA disease activity (including inflammatory markers). Once again, improvements tended to be maintained after interventions ended. A single trial led to inconclusive results on the effects of Iyengar yoga for CTS. Although safety-related data were sparsely reported, no adverse effects on joints have been noted in the trials that included reporting of safety-related events.

Implications for clinical practice

Based on the available data, we conclude there is insufficient evidence to recommend yoga as an independent intervention for chronic neck pain and arthritis. However, given the preliminarily positive findings and the limited available data suggesting no adverse impact on vulnerable joints, yoga can be considered as an ancillary intervention or alternative approach to increasing physical activity in people with chronic neck pain or arthritis. For people with arthritis, yoga may help maintain or even improve physical function and mobility and may offer additional benefits for emotional well-being and HRQOL. Several different yoga styles appear to be effective. However, we caution that some styles that are currently popular (e.g., hot yoga, yin yoga, power yoga) have not been formally evaluated and may not be appropriate for this population.

The dose of yoga varied considerably among studies. Regular engagement in physical activity at a minimum of three times per week is considered necessary to increase physical fitness and confer health benefits among most forms of exercise (Garber et al., 2011). It is unclear what the minimum dose and duration of practice may be for yoga because no studies have directly evaluated this and few studies reported on class attendance.

Both physically based asana interventions and more meditative approaches appear helpful. The specific mechanisms of these heterogeneous interventions have not been adequately explored. There also may be synergistic effects between various aspects of physical (i.e., asana, breathing techniques) and mental (i.e., relaxation, inner focus, meditation) components.

It is important to note that the most common styles of yoga represented in the literature focus on anatomical alignment and/or slow and gentle movements. For people with MSK and neuromuscular concerns, particular attention should be given to the proper modification of poses to address individual limitations and ensure safety. Taibi & Vitello (2011) reported that several participants initially reported some soreness in the shoulder or back and muscle cramping, along with single reports of hand numbness and dizziness in supine poses. Some short-term muscle discomfort may be expected in sedentary adults who begin an exercise program. However, in persons with MSK and neuromuscular issues, adequate protection of vulnerable joints through modification or avoidance of certain poses may be particularly important. Unfortunately, this does not happen consistently in community classes, where teacher training and experience can vary widely. Individuals with these conditions would be best served by seeking out yoga teachers or yoga therapists with additional training in working with individuals with chronic conditions and sufficient experience to adapt practices for individual needs.

Implication for future research

A considerable number of trials on yoga for MSK and neuromuscular conditions other than low-back pain have been conducted to date, with almost 90% of the evidence being published postmillennium, demonstrating growing interest in this research field. However, we note that yoga has only been formally evaluated in a few trials for each condition. Even the best-researched condition, OA, has been the focus of only 11 trials, with a mere 6 being RCTs. CTS has been investigated in only one trial. More research is needed for all included conditions before definite conclusions on the efficacy and safety yoga can be drawn.

Given that the main drawback of the evidence summarized here was the insufficient reporting of trial design and methodology, wherever possible, future studies should adopt an RCT design and ensure rigorous methodology, including adequate allocation procedures and blinding of assessors (Schulz, Altman, & Moher, 2010). Results should be reported in accordance with accepted reporting guidelines (e.g., CONSORT for nonpharmacological treatment interventions). Because the consideration of yoga as a therapeutic intervention is based on both efficacy and safety, adequate reporting of safety-related data is crucial. Researchers should report all adverse events that occurred during the course of the study, as well as any potential causal relationship with the intervention. We strongly encourage sufficient description of specific program components, teacher qualifications and experience, and participant adherence. Large well-conducted multicenter trials are needed to confirm the preliminary findings of small trials. The findings of Indian trials need to be replicated in Western countries before their applicability to the US or European patient populations can be conclusively judged (Cramer et al., 2015).

Interestingly, yoga seemed to be effective regardless of the applied style and even of the content of the interventions. Disentanglement studies on the effects of different yoga components such as postures, breathing, and relaxation, may help to design individually tailored interventions. Although studies with and without asanas appear be effective in individual studies, head-to-head comparisons are needed.

The role of home practice in the effectiveness of yoga for MSK and neuromuscular conditions has not yet been systematically evaluated. Only 11 trials reported that they required or encouraged home practice (Bedekar et al., 2012; Cheung et al., 2014; Cramer et al., 2013c; Ebnezar et al., 2012a, b; Evans et al., 2010; Haslock et al., 1994; Krejci, 2011; Michalsen et al., 2012; Moonaz et al., 2015; Park et al., 2011; Taibi & Vitiello, 2011) and only 3 reported on adherence (Cheung et al., 2014; Cramer et al., 2013c; Taibi & Vitiello, 2011). Future research should develop evidence-based guidelines for including home practice in clinical trials and clinical practice and evaluate the feasibility and impact of including home practice in trials.

Conclusions

Taken together, the available evidence suggests that yoga can be considered as an ancillary intervention for individuals with chronic neck pain and arthritis, based on individual needs and preferences, and in consultation with the health care provider coordinating treatment for the condition. The specific type of yoga must be adapted to the needs and capabilities of participants. We strongly recommend an initial period of practice under the close supervision of qualified instructors who have received additional training in the needs of individuals with MSK and neuromuscular conditions. More well-conducted research is needed in order to understand the potential benefits and risks associated with yoga across MSK and neuromuscular conditions and to evaluate its appropriateness as adjunctive or even primary therapy.

Table 9.1 Study and participant characteristics							
Condition	**Origin**	**Type**	**Sample size**	**Mean age**	**Sex (% female)**	**Diagnosis**	**Main outcomes**
Chronic neck pain							
Cramer et al., 2013c	Germany	RCT	51	47.8 y	82.4%	≥ 3 months of nonspecific neck pain	Group differences for pain (VAS), function (NDI), ROM, PPT, proprioceptive acuity, HRQL (SF-36)
Michalsen et al., 2012	Germany	RCT	77	48.3 y	87.0%	≥ 3 months of nonspecific neck pain	Group differences for pain (VAS), function (NDI, NPAD), HRQL (SF-36), depression (CES-D), anxiety (STAI), fatigue and anger (POMS)
Sharan et al., 2014	India	UCT	8	24.9 y	NR	MPF: Simons criteria	Improvements in pain (VAS), function (NDI, DASH), ROM, grip strength, pinch strength, HRQL (SF-36)
Yogitha et al., 2010	India	RCT	60	41.6 y	53.3%	Nonspecific neck pain	Group differences for pain (VAS), function (NDI), ROM, anxiety (STAI)
Arthritis							
Badsha et al., 2009	UAB	CCT	47	45.0 y	NR	RA (ACR 1987)	Improvements in disease activity (DAS), function (HAQ), but not HRQL (SF-36)
Bedekar et al., 2012	India	CCT	51	61.7 y	70.6%	Knee OA: Criteria NR; total knee replacement	Group differences for pain, stiffness, and function (WOMAC)
Bosch et al., 2009	USA	CCT	20	60.9 y	100%	RA (ACR 1987)	Group differences for function (HAQ), depression (BDI), but not pain (VAS) or balance (BBT)
Cheung et al., 2014	USA	RCT	36	71.9 y	100%	Knee OA (ACR criteria)	Group differences for pain and stiffness (WOMAC), but not function (WOMAC; SPPB), sleep quality (PSQI), HRQL (SF-12), BMI
De G.R Hansen, 2010	USA	UCT	19	NR	NR	OA: criteria NR	Improvements in pain and stiffness (Likert-type scale), but not sleep quality (Likert-type scale)
Ebnezar et al., 2012 a, b	India	RCT	250	59.5 y	69.9%	Knee OA (ACR criteria)	Group differences for pain (WOMAC, NRS) stiffness in minutes, WOMAC), function

							(WOMAC, walking time), ROM, anxiety (STAI), HRQL (SF-36)
Evans et al., 2010	USA	UCT	8	28.0 y	80%	RA (ACR 1987)	Improvements in pain (HAQ), function (on PDI, but not on HAQ), HRQL (SF-36), depression or anxiety (BSI)
Evans et al., 2013	USA	RCT	30	28.4 y	100%	RA (ACR 1987)	Group differences for function (HAQ, PDI), HRQL (SF-36), fatigue (FACIT), but not disease activity (DAS), depression or anxiety (BSI)
Garfinkel et al.,1994	USA	RCT	25	NR	56%	Hands OA: criteria NR	Group differences for pain at motion (VAS), PPT, but not pain at rest (VAS), function (HAQ), ROM, grip strength
Ghasemi et al., 2013	Iran	NRCT	30	52.1 y	100%	OA: criteria NR	Improvements in pain (VAS), function (KOOS)
Haslock et al., 1994	GB	NRCT	20	54.8 y	85%	RA: criteria NR	Group differences for grip strength, but not function (HAQ)
Kolasinski et al., 2005	USA	UCT	11	58.6 y	100%	Knee OA (ACR criteria)	Improvements in pain and function, but not in stiffness (WOMAC), HRQL (AIMS2)
Krejci 2011	Czech Republic	NRCT	112	NR	61.6%	RA or OA: criteria NR; overweight	Improvements in BMI
Moonaz et al., 2015	USA	RCT	75	52.3 y	96%	RA (ACR 1987) or knee OA (ACR criteria)	Group differences for HRQL (SF36) and depression (CES-D), but not for flexibility, balance (OLS), grip strength, 6-minute walk test or disease activity (DAS28)
Nambi and Shah, 2013	India	NRCT	30	53.0 y	43.3%	Knee OA: Kjellgren and Lawrence	Group differences for pain (VAS) and function (WOMAC)
Park et al., 2011	USA	RCT	29	80.0 y	NR	OA: criteria NR	Group differences for function, but not for pain, stiffness (WOMAC), depression (CES-D)
Park and McCaffrey, 2012	USA	UCT	10	77.0 y	NR	OA: criteria NR	Improvements in function and stiffness, but not in pain (WOMAC), depression (CES-D)
Park et al., 2014	USA	RCT	38	79.0 y	76.5%	OA: criteria NR	Group differences for depression (GDS), but not for pain (MPQ)

							function (gait speed, 6-minute walk test), balance (BBT)
Singh et al., 2011	India	RCT	80	35.1 y	70%	RA: criteria NR	Group differences for pain (SDPIS), stiffness (in minutes), disease activity (number of joints), CRP, LC
Taibi & Vitiello, 2011	USA	UCT	14	65.2 y	100%	OA: criteria NR; insomnia	Improvements in insomnia (ISI), but not in sleep quality (PSQI), actigraphy, function (HAQ), depression (GDS)
Telles et al., 2011	India	UCT	64	46.5 y	73.4%	RA: ACR 1987 criteria	Improvements in function (HAQ), grip strength, but not in CRP, rheumatoid factor
Carpal tunnel syndrome							
Garfinkel et al., 1998	USA	RCT	42	48.8 y	66.7%	CTS: 2 out of 5 criteria	Group differences for Phalen sign, but not for pain (VAS), Tinel sign, grip strength, median nerve latency

IMS2: Impact Measurement Scales 2; BBT: Berg Balance Test; BDI: Beck Depression Inventory; BMI: body mass index; BSI: Brief Symptom Inventory; CES-D: Center for Epidemiologic Studies Depression Scale; CRP: C-reactive protein; DAS: Disease Activity Score; DASH: Disabilities of the Arm, Shoulder, and Hand; GDS: Geriatric Depression Scale; HAQ: Health Assessment Questionnaire; HRQL: health-related quality of life; ISI: Insomnia Severity Index; KOOS: Knee injury and Osteoarthritis Outcome Score; LC: lymphocyte count; MPQ: McGill Pain Questionnaire, Short Form; NDI: Neck Disability Index; NPAD: Neck Pain and Disability Scale; NRS: Numerical Rating Scale; OLS: One-leg stand; PDI: Pain Disability Index; POMS: Profile of Moods States; PPT: pressure pain threshold; PSQI: Pittsburgh Sleep Quality Index; ROM: range of motion; SDPIS: Simple Descriptive Pain Intensity Scale; SF-12: Short Form-12 Health Survey; SF-36: Short Form-36 Health Survey; SPPB: Short Physical Performance Battery; STAI: State-Trait Anxiety Inventory; VAS: Visual Analog Scale; WOMAC: Western Ontario and McMaster Universities Arthritis Index; y: year.

Table 9.2 Characteristics of the intervention programs

ConditionStudy	Yoga style	Program length	Frequency	Postures	Breathing techniques	Relaxation/med
Chronic neck pain						
Cramer et al., 2013c	Iyengar	9 weeks	1 × 90 min/week	Yes	No	Yes
Michalsen et al., 2012	Iyengar	9 weeks	1 × 90 min/week	Yes	No	Yes
Sharan et al., 2014	Hatha	4 weeks	60 min daily	Yes	Yes	Yes
Yogitha et al., 2010	MSRT	10 days	20 min daily	No	No	Yes
Arthritis						
Badsha et al., 2009	Vishwas-Raj yoga	6 weeks	2 × 60 min/week	Yes	Yes	Yes
Bedekar et al., 2012	Yogasana	NR	3–7 ×/week (duration NR)	Yes	No	No
Bosch et al., 2009	Hatha yoga	10 weeks	3 × 75 min/week	Yes	Yes	Yes
Cheung et al., 2014	Hatha yoga	8 weeks	1 × 60 min/week	Yes	Yes	Yes
De G.R Hansen et al., 2010	NR	6 weeks	1 × /week (duration NR)	Yes	Yes	Yes
Ebnezar et al., 2012 a, b	Hatha yoga	2 weeks	7 × 40 min/week	Yes	Yes	Yes
Evans et al., 2010	Iyengar	6 weeks	2 × 90 min/week	Yes	No	Yes
Evans et al., 2013	Iyengar	6 weeks	2 × 90 min/week	Yes	No	Yes
Garfinkel et al.,1994	Iyengar	10 weeks	1 × 60 min/week	Yes	No	Yes
Ghasemi et al., 2013	Hatha yoga	8 weeks	3 × 60 min/week	Yes	Yes	Yes
Haslock et al., 1994	NR	6 weeks	1–5 × 120 min/week	Yes	Yes	Yes
Kolasinski et al., 2005	Iyengar	8 weeks	1 × 60–90 min/week	Yes	No	Yes
Krejci, 2011	Yoga in Daily Life	12 weeks	1 × 45–90 min/week	Yes	Yes	Yes
Moonaz et al., 2015	Hatha yoga	8 weeks	2 × 60 min/week	Yes	Yes	Yes
Nambi and Shah, 2013	Iyengar + biofeedback	8 weeks	3 × 60 min/week	Yes	No	Yes

Park et al., 2011	Chair yoga	8 weeks	2 × 45 min/week	No	Yes	Yes
Park and McCaffrey, 2012	Chair yoga	8 weeks	2 × 45 min/week	No	Yes	Yes
Park et al., 2014	Chair yoga	8 weeks	2 × 45 min/week	No	Yes	Yes
Singh et al., 2011	NR	7 weeks	6 × 90 min/week	Yes	Yes	Yes
Taibi & Vitiello, 2011	Hatha yoga	8 weeks	1 × 75 min/week	Yes	Yes	No
Telles et al., 2011	NR	1 week	7 × 300 min/week	Yes	No	Yes
Carpal tunnel syndrome						
Garfinkel et al., 1998	Iyengar	8 weeks	2 × 90 min/week	Yes	No	Yes

MSRT: mind sound resonance technique; min: minute; NR: not reported.

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Musculoskeletal and Neuromuscular Conditions: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

"Yoga can help with carpal tunnel syndrome [CTS], but practiced unskillfully, it can bring on CTS or make it worse," says Timothy McCall. "It's not uncommon to see people in vigorous yoga classes wearing wrist splints or using special props that allow them to keep doing repeated sun salutations, but which unfortunately do nothing to solve the problem." Especially problematic, he says, are poses like handstand in which the wrists are fully extended and bearing weight.

"Part of the problem," McCall says, "is that many people literally bend their wrist in the wrong place, attempting to extend primarily at the radio-carpal junction. When you do that in a pose like downward-facing dog, the proximal row of carpal bones gets jammed into the floor, compressing the carpal tunnel. Correctly done, the opening in the wrist happens not just between the radius and wrist but also between the two rows of carpal bones. When you do that in down dog, the distal row of carpals pushes into the mat, but the proximal row lifts up toward the elbows, which tends to open the carpal tunnel and take the pressure off the median nerve. So depending on how you do the exact same pose, it can either be harmful to your wrists or potentially therapeutic."

McCall uses a variety of techniques to get students to do this action correctly, for example, suggesting that students isometrically flex their wrists in downward-facing dog, putting more weight on the knuckles than the base of the wrist. He might suggest they lift the underside of the forearms away from their hands. Or he might roll a yoga mat and place it under their wrists and proximal palms with their fingers angling down to touch the floor. "The prop allows you to feel what it's like to extend the wrists correctly. Even doing it once this way can help you to reproduce the same feeling when you go back to doing the pose without the aid of the prop. And once you get the principle you can apply it to handstands, side plank pose, crow pose, and so on," says McCall.

"Rotator cuff injuries," reports Loren Fishman, "are usually associated with tearing of the supraspinatus muscle." This muscle, he says, is crucial for "abducting or flexing the arm from 80 degrees to 110 degrees," and patients often report pain and a loss in range of motion in the shoulder. Fishman discovered that the headstand pose, if performed correctly, can sometimes almost instantaneously greatly increase the pain-free range of shoulder motion.

Once a student has raised his or her legs into headstand, with the arms forming a tripod, Fishman will say to the student, "Press down with your elbows and proximal forearms, lifting both shoulders away from your ears while keeping your head on the blanket." When students follow these instructions (Fishman recommends holding the pose for 30–45 seconds), it causes the subscapularis muscle to contract. Rather than placing the crown of the head on the floor, he recommends moving the contact point toward the anterior fontanelle, which makes it easier to do the pose with a healthy cervical curve.

Because many people cannot safely perform a headstand, Fishman recommends either doing a version with the legs supported by a chair (see Fig. 9.1A) or standing, folded forward at the hips with the arms and head against the wall (see Fig. 9.1B). The standing version, Fishman reports, appears to be somewhat less effective than the regular headstand, and the chair version appears to be the most effective, because balance is not an issue, there‘s less weight on the head, and the student can focus on lifting the shoulders. Fishman reports a greater than 90% success rate for over 1,200 patients with MRI-confirmed rotator cuff syndrome so far.

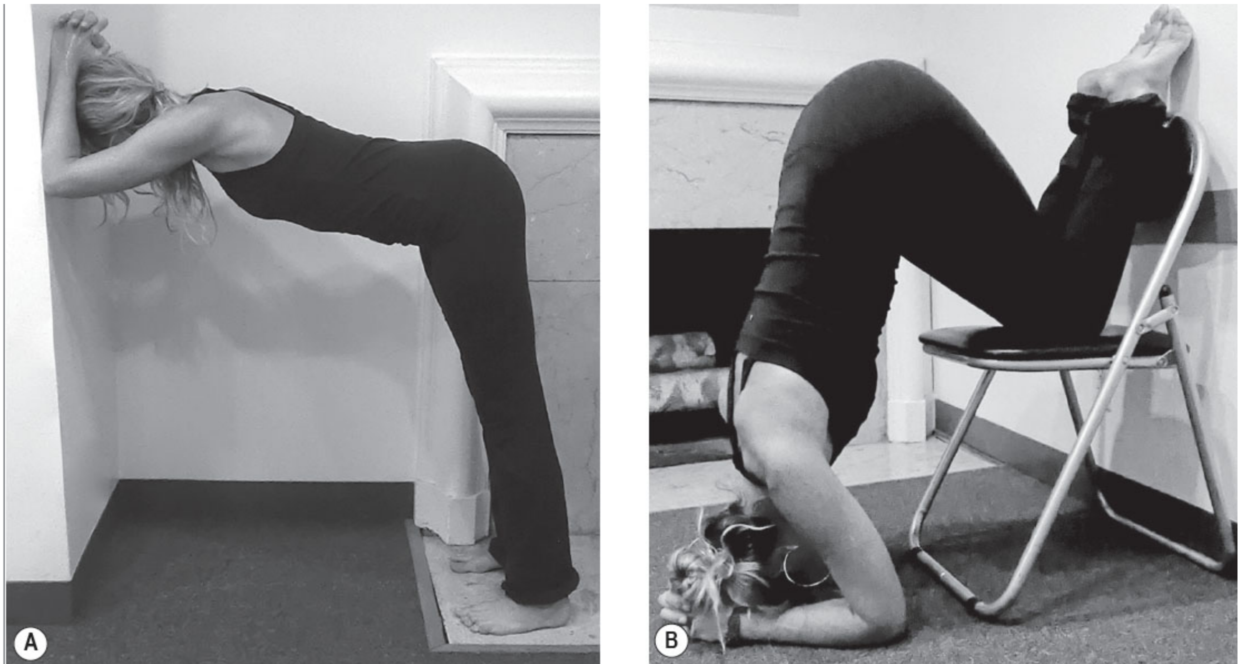

Fig. 9.1 A, B

Two headstand variations used for rotator cuff injuries.

Reproduced with permission from Cypress Dubin, NYC, USA

A major cause of supraspinatus tears, as well as shoulder tendonitis, bursitis, and adhesive capsulitis, according to Julie Gudmestad, is shoulder impingment between the greater tubercle of the humerus and the acromion. This occurs, she says, because of the "tendency to internally rotate the shoulder in all activities and positions, including yoga poses. The internal rotation approximates the greater tubercle and the acromion, setting the stage for impingement of adjacent soft tissue."

Gudmestad says, "Muscle imbalances include short, tight internal rotators (latissimus dorsi, pectoralis major, and subscapularis, etc.), which tend to internally rotate the shoulder as they are stretched while coming into full flexion. The prime external rotators, teres minor and infraspinatus, are usually weak. Additionally, the serratus anterior, the prime mover in upward rotation of the scapula, may be weak."

In students who are able to do it, Gudmestad suggests, "Practice weight-bearing on the arms with the shoulders in full flexion (downward-dog pose) or 90 degrees of flexion (hands and knees, knees-on-floor plank, or full plank pose) to strengthen the serratus anterior. Strengthen the external rotators by externally rotating the humerus in most yoga poses. Stretch the pectoralis major and latissimus dorsi by lying over a rolled blanket across the upper scapula, and then stretch the arms overhead—support the hands with props if shoulder range of motion is limited—being sure to externally rotate the upper arms."

"With care, yoga can be useful and safe for osteoporosis," says Carol Krucoff. One pose she recommends is a variation on cat/cow that she calls "spinal balance." To do the pose, she instructs, "Come onto all fours, wrists under shoulders, knees under hips. Inhale as you extend your right arm forward and left leg back. Exhale back to all fours. Inhale as you extend your left arm forward and right leg back. Exhale back to all fours." If this proves too difficult, she suggests having the student extend either an arm or a leg, but not both. For those who are ready for more challenge, she says, "Stay in the balance through several breath cycles."

"Postures done supine, prone, or side-lying—on the floor or in a bed—may be the safest, as this position places the least load on the spine," Krucoff says. "The second-safest position is standing with good alignment. Sitting increases the load on vertebral bodies—with slouched sitting even worse—making seated forward bends particularly risky. Sitting plus twisting, especially to end range, may greatly increase risk of vertebral fracture."

Krucoff says, "Teaching people proper alignment and good body mechanics is essential. In particular, it's important to teach people to maintain a neutral spine during activities of daily living, such as when lifting and carrying. Teaching people to hinge at the hips, *not* at the waist, when bending forward is very useful. In yoga practice, to keep a neutral spine, many people will need to bend their knees in postures such as downward-facing dog and *uttanasana* [standing forward bend]."

Fishman developed a routine to treat patients with osteopenia and osteoporosis. "We have used *trikonasana* [triangle pose], *parivrtta trikonasana* [revolved triangle pose], *vriksasana* [tree pose], *parsvakonasana* [extended side-angle pose], *salabhasana* [locust pose], *setu bandhasana* [bridge pose], *marichyasana* 1 [Marichi's pose 1], *matsyendrasana* [a seated spinal twist], and *supta padangusthasana* 1 and 2 [reclining big-toe pose 1 and 2] and have slowed down, arrested, or reversed osteoporosis in more than 80% of our patients," based on DEXA scans at the onset and then 2 years later. He suggests, "Start slowly and carefully, but encourage and inspire students to work quite intensively, at the level of great safety but also considerable effort." He reports that in over 5 years and over 70,000 hours of students doing this practice, "So far there are no reported fractures related to the yoga in any way."

Resources

Book: *Healing Yoga for Neck and Shoulder Pain* by Carol Krucoff

Book: *Yoga for Arthritis* by Loren Fishman and Ellen Saltonstall

Book: *Yoga for Osteoporosis* by Loren Fishman and Ellen Saltonstall

Article: Fishman LM, Konnoth C, Polesin A. “Headstand for rotator cuff: Shirshasana or Surgery.” *International Journal of Yoga Therapy* . (16) 2006: 39–47

CHAPTER TEN

YOGA THERAPY FOR NEUROLOGICAL AND IMMUNE CONDITIONS

E KOZASA • D SANTAELLA • S MISHRA • B TRIKAMJI

Introduction

It may seem odd that yoga can be applied to a variety of neurological and immune disorders such as pain, fibromyalgia, autism, traumatic brain injury (TBI), arthritis, and Alzheimer's disease. In this chapter, however, we will present some evidence that yoga may have a role in the treatment of these conditions by improving physical or psychological aspects as well as the quality of life of patients diagnosed with neurological and immune disorders.

Pain

A frequent characteristic of these disorders is pain. In many cases, pain is a chronic condition, and the patient must learn to cope with it in daily life. One of the broad applications of yoga is its potential to alleviate pain and to help patients develop better strategies to cope with it. Pain is a complex experience that varies widely between people and even within a single person. Chronic pain is one of the most prevalent health problems in the modern world, affecting millions of people. To manage this problem, many people are adopting mind–body therapies, such as meditation and yoga, which may help in the modulation of pain by altering cognitive and emotional responses to pain. There is an intrinsic relationship between pain, emotion, and cognition: pain may have a negative effect on emotions and cognitive function; conversely, negative emotion can lead to increased pain and a positive attitude can reduce it. Similarly, attention and memory can either increase or decrease pain. Attention and emotion alter pain via different descending modulatory systems. Emotions activate circuitry involving the anterior cingulate cortex, prefrontal cortex, and periaqueductal grey matter; attention activates circuitry involving projections from the superior parietal lobe to the primary somatosensory cortex and insula (Bushnell, Ceko, & Low, 2013).

Meditation reduces pain-evoked prefrontal cortex activity but increases activity in the rostral anterior cingulate cortex and the anterior insula (areas involved in the cognitive regulation of nociceptive processing) (Grant, Courtemanche, & Rainville, 2011). One study showed that meditators have thicker cortices in frontal regions, including the prefrontal cortex, anterior cingulate cortex, and insula (Lazar et al., 2005).

Villemure, Ceko, Cotton, & Bushnell (2014) investigated possible neuroanatomical mechanisms of the beneficial effects of yoga using sensory testing and magnetic resonance imaging techniques. North American yoga practitioners tolerated pain more than twice as long as individually matched controls and had more gray matter (GM) in multiple brain regions. Insular GM correlated with pain tolerance. Yoga practitioners, as opposed to controls, used cognitive strategies involving parasympathetic activation and interoceptive awareness to tolerate pain, which could have led to use-dependent hypertrophy of the insular cortex. Together, these findings suggest that regular and long-term yoga practice improves pain tolerance and leads to a change in insular brain anatomy and connectivity.

Stroke

An estimated 6.8 million people in the United States suffered a stroke in 2010, and more than half of them were women (3.8 million) (Go et al., 2014). According to this survey, at the moment of a stroke, women are older, are more likely to be living alone, and have worse premorbid status than men. After a stroke, women are also more likely to have a poorer recovery and a worse quality of life than men (Bushnell et al., 2014). On a global scale, stroke incidence ranges from 41 per 100,000 people annually in Nigeria (1971–74) to 316/100,000/year in urban Dar-es-Salaam (Tanzania) (Thrift et al., 2014). Most people who have had strokes have mild to moderate neurologic deficits following the stroke. They also experience compromised health status and reduced quality of life (Duncan et al., 1997).

There is some evidence that yoga may be beneficial to people who have had a stroke. In a preliminary investigation addressing the effects of a yoga-based exercise program in people with chronic poststroke hemiparesis, four participants took part in a case study where the outcome measures were the Berg Balance Scale (BBS), the Timed Movement Battery (TMB), and the Stroke Impact Scale (SIS). The 8-week intervention phase consisted of 1.5-hour yoga sessions, 2 times a week, in the subject’s home. Three of the four participants had improved TMB scores, and two of them had improved BBS scores (Bastille & Gill-Body, 2004). A common side effect of stroke is balance impairment. The purpose of a randomized pilot study proposed by Schmid et al. (2012) was to assess the impact of a yoga-based rehabilitation intervention on balance, balance self-efficacy, fear of falling (FoF), and quality of life after stroke. All yoga sessions were taught by a certified yoga therapist, occurred twice a week for 8 weeks, and included seated, standing, and floor postures with relaxation and meditation. Balance was assessed with the Berg Balance Scale, balance self-efficacy with the Activities-specific Balance Confidence (ABC) Scale, FoF was evaluated with a dichotomous yes/no question, and quality of life with the Stroke Specific Quality of Life scale. There were no significant differences between the waitlist control (n = 10) and yoga (n = 37) groups; however, using within-group comparisons, the yoga group data indicated significant improvement in balance and FoF. The authors concluded that a yoga-based rehabilitation intervention for people with chronic stroke has potential in improving multiple poststroke variables, and that this cost-effective intervention may be complementary to traditional rehabilitation in medical-based and community-based settings.

In a small pilot study (three participants) designed to explore the hypothesis that a 12-week practice of kundalini yoga would lead to an improvement in aphasia as well as in fine motor coordination in stroke patients, participants attended yoga classes twice a week. Prestudy, participants were tested on the O'Connor Tweezer Dexterity test, a timed test where the participant places pins in a peg-board with tweezers, and underwent the Boston Aphasia Exam for speech. The three participants showed improvement on both measures; however, the small sample size makes it impossible to draw definite conclusions (Lynton, Kligler, & Shiflett, 2007).

Yoga seems to be a promising practice for stroke patients; however, controlled clinical trials with a bigger number of participants should be conducted.

Traumatic brain injury

Traumatic brain injury (TBI) is a major public health problem (Hon Ping et al., 2014). Every year, approximately 1.7 million Americans sustain a TBI (Sarah, 2011), which may have a multitude of distinct consequences. Regardless of which brain area is injured, patients experience a range of symptoms, including cognitive, emotional, behavioral, and physical disturbances, manifested as disturbed consciousness, impaired attention, slowed processing, working memory problems, memory disturbance, communication impairments, executive dysfunction, depression, anxiety, irritability, rage, agitation, aggression, disinhibition, apathy, sleep disturbance, headaches, decreased respiratory capacity, pain, visual problems, dizziness or vertigo, and seizures (Ma et al., 2014). Amongst these, sleep disturbance, increased anxiety and depression, chronic pain, headaches (Conzen et al., 1992), and behavioral problems (Beetar, Guilmette, & Sparadeo 1996) are the most common, resulting in decreased quality of life (Dombovy & Olek, 1997; Ommaya et al., 1996). In fact, depression is one of the most functionally impairing post-TBI symptoms, and it may respond to a combination of rehabilitative and pharmacologic treatments (Silver, McAllister, & Arciniegas, 2009). Although the traditional medical approach towards TBI treatment has been well established, complementary medicine techniques may have an additive positive effect (Purohit et al., 2013), especially if these involve psychophysiological interventions, such as yoga. Although not specifically demonstrated in TBI patients, it has been shown that the practice of postures and postures associated with breathing exercises has positive effects on migraine, depression, and anxiety (Pilkington, Kikwood, Rampes, & Richardson, 2005); insomnia (Afonso et al., 2012); social behavior; and posttraumatic stress (Descilo et al., 2010). Thus, it is feasible to infer that it may also be beneficial for TBI patients, who are prone to such symptoms.

Randomized controlled trials (RCTs) investigating the use of yoga as therapy for TBI are currently lacking, and most of the information available on yoga and TBI comes from outside of formal research. In the only study about the interaction of yoga and TBI performed so far, Siverthorne et al. (2012) addressed the utility and applicability of yoga breathing exercises on 10 patients with severe TBI, and after a 40-week training period the authors concluded that even a 30-minute weekly class had beneficial results. The nature of the brain injuries was not controlled for; but even though the participants exhibited severe physical disability, they had adequate cognitive functioning and were able to engage properly in the yoga practices. The yoga group showed significant longitudinal change on several measures of observed respiratory functioning (apnea period, resting heart rate, holding a vocal tone, expiration and inspiration time), and self-reported physical and psychological well-being (general health, pain, emotional well-being, and physical functioning). The authors state that these results provide preliminary support for the benefit of breath-focused yoga for adults with severe TBI. Given the reduced external validity of a small-sample-sized study, these findings cannot be generalized to younger individuals, populations with less-severe head trauma, or to those with TBI associated with other psychoemotional stressors, such as military combat. Nonetheless, the authors suggest that yoga may be a valuable intervention for the population with TBI.

Cantor and Gumber (2013) recently published a meta-analysis about the use of complementary medicine, including yoga, for TBI. The only study found addressing the use of yoga for TBI was that previously cited in this text. As a conclusion of their broad analysis, the authors concluded that, due to the high risk of bias in most of the studies reviewed, the evidence base is inadequate to recommend any specific complementary and alternative medicine treatments for TBI, although promising findings were identified for a number of treatments. Thus, further investigation is needed to strengthen background information about the effects and applicability of as a complementary therapy for TBI.

Yoga and fibromyalgia

Fibromyalgia is a debilitating chronic pain condition, affecting approximately 15 million people in the United States, and is one of the more severe disorders in the scope of persistent pain (Mist, Firestone & Jones 2013; White & Harth, 2001). This condition is characterized by heightened generalized sensitization to sensory input, presenting a complex of symptoms such as widespread musculoskeletal pain and stiffness, fatigue, disturbed sleep, dyscognition, affective distress, and reduced quality of life (Mishra, Singh, Bunch, & Zhang, 2012; Ledingham, Doherty, & Doherty, 1993). Since its physiopathology may include central nervous system dysfunction related to pain modulation, as well as neuroendocrine dysfunction and dysautonomia, interventions with low side effects such as physical and behavioral approaches may be valuable contributors for its treatment.

Carson and colleagues (Carson et al., 2010) addressed the effects of yoga on 53 female patients with fibromyalgia. Participants were randomized either to an 8-week yoga program (gentle poses, meditation, breathing exercises, coping methods, and group discussions) or to a waitlist of standard care. The yoga group showed significant improvements in fibromyalgia symptoms such as pain, fatigue, stiffness, sleep problems, depression, memory, anxiety, tenderness, balance, vigor, and strength. In addition, participants exhibited psychological improvements in coping with pain through greater utilization of adaptive pain strategies such as problem solving, acceptance, relaxation, and activity engagement and decreased use of maladaptive strategies such as confrontation, self-isolation, disengagement, and catastrophizing. At 3-month follow-up, the authors concluded that yoga practitioners maintained the beneficial effects of the yoga intervention, and patients who practiced more often maintained a greater amount of benefits, such as increased daily relaxation; lower daily pain, fatigue, and distress; and higher daily vigor. Goldenberg and co-workers (Goldenberg et al., 1994) showed significant improvements in fibromyalgia symptoms with a stress-reduction, cognitive-behavioral treatment program in an RTC involving 79 fibromyalgia syndrome patients. After a 10-week intervention, symptoms improved in 67% of the participants in the test group compared to 40% in controls. The program led to a reduction of 16% in the mean visual analog scale (VAS) and 11% in the mean Fibromyalgia Impact Questionnaire (FIQ) scores of the test participants compared to the controls. These represent improvements in global well-being, pain, sleep, fatigue, tiredness upon awakening, and overall functional status among fibromyalgia patients. Psychological status improved by 32% among test participants compared to controls. Another study (Curtis, 2011) showed that two classes of 75 minutes of comprehensive hatha yoga practice plus meditation for a period of 8 weeks had significant positive effects on continuous pain, pain catastrophizing, pain acceptance, and mindfulness. Hennard (2011) studied the effects of an 8-week training program of yoga and meditation to help manage fibromyalgia symptoms. This study of 11 participants found significant improvement in the overall health status of the participants and in symptoms of stiffness, anxiety, and depression; significant increases were also reported in the number of days individuals scaled as “felt good” and reduction in the number of days they missed work. Da Silva, Lorenzi-Filho, and Lage (2007) randomly investigated the effects of 8 weeks of hatha yoga training or hatha yoga plus tui na massage therapy in 40 female patients with fibromyalgia. Both groups had significant improvements, including lower scores in the Fibromyalgia Impact Questionnaire (FIQ) and in the VAS for pain. At follow-up, however, only the yoga group maintained these improvements. The authors conclude that isolated hatha yoga may be a better approach than when combined with tui na massage and that yoga is a valid and useful adjunct therapeutic method for fibromyalgia patients. The authors suggest that for long-term benefits, it may be a good approach to teach fibromyalgia patients to fully participate in therapeutic programs, which may help to change self-defeating beliefs by taking responsibility for their own self-care.

Altogether, these data indicate a possible application of yoga as a complementary therapy for fibromyalgia, although a greater number of controlled randomized investigations are necessary to foster a stronger data set about the subject.

Autism spectrum disorder

As defined by Leo Kanner back in 1943, children with autism have an innate inability to form the usual biologically provided affective contact with people (Kanner, 1943). He suggested that individuals with autism have difficulty reacting to the input of new stimuli encountered on a daily basis and that they live in a world of sameness and aloneness, which if disturbed, causes them to fall into a major panic that does not cease until removal of the perturbation agent. These days, it is well known that a dysfunction of the GABAergic signaling early in a child's development leads to a severe excitation/inhibition imbalance in neuronal circuits, which may be responsible for some of the behavioral deficits observed in individuals on the autism disorder spectrum (Pizzarelli & Cherubini, 2011).

According to Studnitzer & Miller (2014) this inability to react and process sensory stimuli affects 80–90% of children on the autism spectrum, and their sensory processing deficit may contribute to the maladaptive behavioral profile of these children and impact their ability to participate in social, school, and home activities. The authors propose that because of the behavioral issues, treating this sensory processing disorder with sensory integration therapy may help eliminate or at least lessen these negative behaviors, since it stimulates the neurological processes that organize sensation from one's own body and from the environment, making it possible to use the body effectively within the environment (Ayres, 1972). Yoga may be a beneficial therapy, because it utilizes the influence of the mind in balancing physical performance with the calm and serenity of positive thoughts (White & Harth, 2001). Furthermore, it is believed that yoga interventions may increase brain gamma-aminobutyric acid (GABA) levels and can be used as complementary therapies in conditions such as depression, anxiety, and autism spectrum disorder (ASD) (Streeter et al., 2010; Streeter et al., 2007). Streeter and colleagues' results indicate that in experienced yoga practitioners, brain GABA levels are significantly increased and anxiety reduced after a session of yoga. This suggests that the practice of yoga could be explored as a treatment for disorders with low GABA levels.

In fact, there are four recent well-controlled studies that investigated the influences of yoga on ASD. Radhakrishna (2010) carried out a 10-month program of 5-weekly 45-minute hatha yoga sessions with regular home practice in a group of six individuals with ASD. Practices included warm-up asanas consisting of jogging, bending, and twisting exercises, and selected asanas with the following sequential characteristics: stretching, release of tension, calming asanas and breathing asanas (blowing air in and out during postures). Authors found significant increases in nonverbal communication, self-esteem, emotional bonding, focus, tolerance to touch, proximity, and sharing of attention after the 10 months of the study. In addition, children exhibited increased skills in eye contact, sitting tolerance, and receptive skills to verbal commands related to spatial relationship and vocalization, since children increased vocal imitation skills by imitating vowels “a, e, i, o, u” and “Om”, and children's parents reported they started indicating basic needs using gestures, interacting with other children during play situations, and increased sitting tolerance for an activity. The study author, supported by the study results, concluded that yoga therapy may offer benefits as an effective tool to increase imitation, cognitive skills, and social-communicative behaviors in children with ASD. Another study addressed a school-based manualized daily yoga program for 16 weeks, versus a control group (standard activity), assessing challenging behaviors and behavior coding before and after intervention. The intervention group showed significant improvement in teacher ratings of maladaptive behavior, indicating that the use of daily classroom yoga interventions may significantly and positively impact classroom behaviors in children with ASD (Koenig, Buckley-Reen, & Garg, 2012). Another study, by Radhakrishna, Nagarathna, and Nagendra (2010), investigated an integrated approach to yoga therapy applied to individuals with ASD over a period of two academic years in a two-arm controlled trial. The authors pointed out that parental presence while instructions were passed by the instructor on a one-to-one basis allowed firm and consistent guidance to be given to each child, and resulted in significant improvements in the children in eye-to-eye gaze, sitting tolerance, body posture, body awareness, depth perception and balance, imitation skills, self-stimulatory behavior, receptive skills regarding spatial relationships, and self-injurious behavior. In addition, the authors indicated improvements in behavior at home and family relationships. The authors also hypothesized that guided imitation of therapist body positions stimulated mirror neuron activation in the children, resulting in an improved sense of self.

In conclusion, and in accordance with Ehleringer (2010), the evidence allows us to state that yoga can improve focus and attention, sensory information processing, communication, self-regulation, and motor control, in children with ASD, helping them to lead more balanced, healthy, socially integrated, and independent lives. Yoga practice may help these individuals to improve their cognition and emotional processing.

Yoga and headache

Headache is one of the most common neurological disorders. It is classified into primary headache involving migraines and tension-type headaches and secondary headache involving problems due to structural lesions in the head and neck. Evaluating a patient with new-onset headache pain can be challenging; it requires a systematic approach based upon an understanding of common headache syndromes, and making a correct diagnosis is the first step in the proper management of headache patients. The management of headache depends on the specific headache type and the presence or absence of medication overuse. Migraine headaches afflict 13% of the US population (Victor et al., 2010). The personal and societal burden is enormous, affecting quality of life and costing the United States $11 billion annually, as demonstrated by the migraine-associated national expenditure estimates: outpatient care, $5.21 billion; prescriptions, $4.61 billion; inpatient care, $0.73 billion; and emergency department care, $0.52 billion (Hawkins, Wang, & Rupnow, 2008). A national survey showed that adults with headaches judged CAM (complementary and alternative) therapies to be more helpful than conventional care for treatment of headaches (Eisenberg et al., 2001). Wells and colleagues (Wells, Phillips, Schachter, & McCarthy, 2010) reported that adults with common neurological conditions used CAM more frequently than those without (44.1 vs. 32.6%, $p < .0001$). However, little is known about the patterns of CAM use in adults with migraines. Only a few surveys have examined CAM use in patients with headaches, and most were conducted in outpatient headache centers with small samples (Rossi et al., 2005; Gaul et al., 2009).

Yoga as a relaxation technique can be of aid in the management of tension-type headaches. Sethi, Trivedi, & Anand (1981) first described the effectiveness of corpse pose in tension-type headaches. In an RCT of participants with mixed migraine and tension headache, yoga, in addition to standard medication, produced a significant reduction in headaches when compared to standard medication alone (Latha & Kaliappan, 1992). In a controlled prospective nonrandomized study of 24 female participants, it was found that Iyengar Hatha yoga for a period of 3 months (whether once or twice a week) significantly reduced the pain caused by headaches and lower back (Michalsen et al., 2005). John and colleages (John, Sharma, Sharma, & Kankane 2007) conducted an RCT to study the effectiveness of yoga therapy in the treatment of migraine without aura. The study involved 72 participants with migraine without aura who were randomly assigned to yoga therapy or self-care group for 3 months. The study indicated a significant reduction in headache intensity ($p < .001$), frequency ($p < .001$), and other associated clinical features in the yoga group compared to the self-care group. Another RCT was conducted on 60 individuals with migraines who received either conventional care or yoga with conventional care for a period of 6 weeks. Although significant clinical improvement was seen in both groups, headache frequency and intensity were reduced more in the yoga with conventional care group than the conventional care group alone. Furthermore, yoga therapy enhanced the vagal and decreased the sympathetic heart modulations, expressed respectively by the high and the low frequencies of heart rate variability evaluated by spectral analysis, hence improving the cardiac autonomic balance (Kisan et al., 2014).

Migraine is a neurovascular disorder, and any intervention that improves endothelial function may contribute to the treatment of migraines as well as to the prevention of vascular complications such as ischemic stroke. Recently, the preventive effect of a 3-month yoga intervention on endothelial function in patients with migraine was reported in 42 women (Naji-Esfahani et al., 2014). To study endothelial function, a blood test was performed on all patients to measure plasma levels of intercellular adhesion molecules (ICAMs) and vascular cell adhesion molecules (VCAMs) after a yoga training program. Although the ICAM levels were the same, there was a significant decrease in plasma level of VCAMs in the yoga group compared with the control group, demonstrating the efficacy of yoga in improving vascular functions among individuals with migraine (Naji-Esfahani et al., 2014).

The efficiency of yoga in the management of tension-type headache is well known. In one study, with 15 patients with chronic tension-type headaches, the EMG records revealed a significant decrease in the mean EMG amplitude of the temporalis during rest and mental activity after a yoga-based intervention ($p = .03$), supporting the beneficial effect of yoga (Bhatia et al., 2007). In an epidemiological survey of CAM therapies among 110 Turkish patients with primary headaches, it was found that 31% practiced yoga as a tool to manage their ache (Karakurum et al., 2014). In another study, of 124 Italian children with pediatric headache, it was found that 76% used CAM therapies, of which yoga was practiced by 33% (Dalla Libera, Colombo, Pavan, & Comi, 2014). The beneficial effects of yoga on secondary headaches due to myofascial pain syndrome of neck was reported by Sharan et al. after a 2-month course of yoga (Sharan, Manjula, Urmi, & Ajeesh, 2014). In summary, yoga can be an effective practice to reduce tension and induce relaxation, helping to reduce headaches and migraines.

Yoga and Alzheimer’s dementia

Dementia is a syndrome in which there is deterioration in memory, thinking, behavior, and the ability to perform everyday activities. Although dementia mainly affects older people, it is not a normal part of aging. According to the World Health Organization, worldwide, 47.5 million people have dementia and there are 7.7 million new cases every year. Alzheimer’s disease is the most common cause of dementia and may contribute to 60–70% of cases. Dementia is one of the major causes of disability and dependency among older people worldwide. Dementia has a physical, psychological, social, and economic impact on caregivers, families, and society. In a Taiwanese study of 68 elderly individuals with dementia at a long-term care facility, the use of silver yoga exercises (warm-up, hatha yoga, relaxation, and guided-imagery meditation) over a period of 3 months showed remarkable improvement in both physical and mental health in the yoga-trained group when compared to the control group. In addition, depression and behavior challenges of these elders with dementia were significantly reduced (Fan & Chen, 2011). With the practice of Vihangam yoga meditation, a concentration technique, Hu, Chang, Prakash, & Chaudhury (2011) found that long-term Vihangam yoga practitioners were superior in sustained attention, selective attention, prepotent inhibition, and set-shifting tasks as compared to matched non-meditators. Hariprasad et al. (2013) examined the benefits of a yoga-based intervention compared with a waitlist control group on several domains of cognitive function in the residents of homes for the elderly. Of the 87 participants recruited for the study, the yoga group received yoga sessions daily for 1 month and weekly until the third month and were encouraged to continue unsupervised for a further 6 months. At the end of the 6 months, the yoga group showed significant improvement in immediate and delayed recall of verbal and visual memory, attention and working memory, verbal fluency, executive function, and processing speed than waitlist group. Besides the advantages of yoga on cognition in Alzheimer's disease, the beneficial effects of chair yoga on physical activity was indicated by McCaffrey, Park, Newman, & Hagen (2014) in a group of older adults with moderate and severe Alzheimer's disease.

Although families traditionally have been the major providers of aid and support for their members in times of need, providing care for a family member with dementia is a progressively overwhelming experience for the caregiver. Caregiving for those with dementia has been associated with increased levels of depression, anxiety, and anger; higher use of psychochoactive medications; worse physical health and immune function; and increased mortality (Tremont, 2011). In a study of 12 family caregivers of elderly female patients with dementia who participated in a six-session manual-based yoga-meditation program, pre/post comparisons revealed significant reductions in depression and anxiety and improvements in perceived self-efficacy. Average minutes of weekly yoga-meditation practice were significantly associated with improvements in depression. The majority of caregivers found the intervention useful and reported subjective improvements in physical and emotional functioning (Waelde, Thompson, & Gallagher-Thompson, 2004). Another study looked at the effectiveness of yogic meditation for family dementia caregivers with depressive symptoms. Thirty-nine family dementia caregivers were randomized to practicing Kirtan Kriya or listening to relaxation music for 12 minutes per day for 8 weeks. The meditation group showed significantly lower levels of depressive symptoms and greater improvement in mental health and cognitive functioning compared with the relaxation group (Lavretsky et al., 2013).

Yoga may be a strategy to improve cognitive functions as well as psychological outcomes in patients with Alzheimer's disease, and a practice to alleviate stress in their caregivers.

Yoga and Parkinson's disease

According to the Parkinson's Disease Foundation, an estimated 7–10 million people worldwide are living with Parkinson's disease (PD) today. Close to 1 million Americans live with PD, which is more than the combined number of people diagnosed with multiple sclerosis, muscular dystrophy, and Lou Gehrig's disease (ALS). Approximately 60,000 Americans are diagnosed with PD each year, and this does not include the thousands of cases that go undetected. The combined direct and indirect cost of Parkinson's, including treatment, social security payments, and lost income from inability to work, is estimated to be nearly $25 billion per year in the United States alone. Medication costs for an individual person with PD average $2,500 a year and therapeutic surgery can cost up to $100,000 per patient.

In an epidemiological survey of 300 Argentinians, 63.7% used CAM therapies, of which 25.7% used CAM therapies for PD symptoms. Of these, 38% used yoga followed by acupuncture (38%) and homeopathy (32%) (Pecci et al., 2010). Hall, Verheyden, & Ashburn (2011) reported objective improvements in functional activities after a 2-month yoga session in a 69-year-old female with an 8-year history of PD. Moriello et al. (2013) incorporated yoga into an intense physical therapy program in a 57-year-old individual with a 2-year history of PD. The participant performed an intense 1.5-hour program incorporating strengthening, balance, agility, and hatha yoga exercises twice weekly for 12 weeks. He then completed a new home-exercise program developed by the researchers for 12 weeks. There were improvements in muscle length, muscle strength, dynamic balance, and activity of daily living.

It is important to design studies with a bigger sample of patients with PD for the understanding of the effects of yoga practices in these group.

Yoga and neurological and immune disorders

Multiple sclerosis (MS) is the most common autoimmune inflammatory demyelinating disease of the central nervous system. MS mostly affects younger adults and it has higher incidence in females than males. According to the Multiple Sclerosis International Federation (2013), the estimated number of people with MS increased from 2.1 million in 2008 to 2.3 million in 2013. The global median prevalence used to calculate this figure increased from 30 per 100,000 in 2008 to 33 per 100,000 in 2013. Although the severity of the disease varies from milder to more progressive forms, treatment primarily treats the symptoms of MS rather than the cause. Patients with MS frequently complain of autonomic, visual, motor, and sensory problems. These symptoms are determined by the location of the lesions within the nervous system, and may include loss of sensitivity or changes in sensation such as tingling, pins and needles or numbness, muscle weakness, muscle spasms, or difficulty in moving; difficulties with coordination and balance (ataxia); problems with speech or swallowing; visual problems (nystagmus, optic neuritis, or double vision); fatigue and acute or chronic pain; and bladder and bowel difficulties, among others. Difficult thinking and emotional problems such as depression or an unstable mood are also common. The current treatment regimens only prevent further progression of the disease but cannot cure it. This makes yoga potentially valuable in the management of this disorder. In an epidemiological study of CAM therapies among people with MS in Nordic countries, it was found that the prevalence of yoga varied between 9% and 23% (Skovgaard et al., 2012).

In 1997, an anonymous poll sent to 129 patients diagnosed with MS in Germany reported that 63% of patients used some form of alternative therapy, nearly half of these being some form of yoga meditation (Winterholler, Erbguth, & Neundörfer, 1997). In another RCT to study the effects of yoga and exercise on 69 patients with MS, it was found that weekly Iyengar yoga classes helped improve fatigue after a period of 6 months (Oken et al., 2004).

Several surveys indicate that yoga is practiced by 13% to 23% of people with MS and that more than half of these find it to be highly beneficial (Page et al., 2003; Nayak, Matheis, Schoenberger, & Shiflett, 2003; Stuifbergen, & Harrison, 2003). In a survey of Oregonians, Yadav & Bourdette (2006) compared the “very beneficial” ratings of yoga to ratings of conventional exercise modalities, such as water aerobics, swimming, stretching, and walking, by the respondents. A significantly higher percentage of respondents rated yoga (49%) as “very beneficial” compared with walking (40%; p = .001). Among the various interventions used for decreasing the symptoms of depression and improving quality of life in MS patients, Walker & Gonzalez (2007) found that the attrition rate for yoga and exercise was 17%. In a survey of 1,573 people with MS in Germany, 1,100 (70%) reported lifetime use of at least one CAM therapy for MS or MS-related symptoms. Of these, 12% confirmed the use of yoga for symptom management (Schwarz, Knorr, Geiger, & Flachenecker, 2008). In a survey of 138 persons with MS in the United Kingdom, Esmonde and Long (2008) found that 84% had used CAM therapies in the past year, of which 31% found yoga helpful. The participants found yoga to be relaxing and helpful with their balance, mobility, flexibility, spasticity, muscle strength, and general well-being. They also found hatha yoga to be the most helpful of all the kinds of yoga. Velikonja, Curić, Ozura, & Jazbec (2010) could not find any beneficial effects of hatha yoga on spasticity, cognition, mood, and fatigue, but reported a 17% increase in selective attention performance in a group of 20 participants with MS. However, two studies have found that a training period of 4–6 months of yoga improved cognitive function, lessened fatigue, and improved the disposition and the quality of life of seniors with MS (Ahmadi et al., 2010, Oken et al., 2004). A clinical trial involving 60 Iranian women reported a significant improvement in physical pain management (p = .007) and quality of life (p = .001) with yoga when compared to a control group. The results showed that yoga techniques can alleviate physical pain and improve the quality of life of patients with MS (Doulatabad, Nooreyan, Doulatabad, & Noubandegani, 2012). Coote, Hogan, & Franklin (2013) studied the prevalence of falls in people with MS and found a major decrease in falls after yoga but the findings were not statistically significant.

Overall, exercise interventions including yoga have been shown to improve psychological aspects of functioning, including mood (Oken et al., 2004; Petajan et al., 1996; Sutherland, Andersen, & Stoove, 2001) and depression (Velikonja, Curić, Ozura, & Jazbec, 2010; Hoogervorst et al., 2004) in MS.

Neurogenic bladder dysfunction is a common distressing symptom in MS affecting quality of life. Patil and colleagues (Patil, Nagaratna, Garner, Raghuram, & Crisan, 2012) used integrated yoga, which included preparatory yogic relaxation and breathing practices, *nadishuddi* pranayama (alternate-nostril breathing), *mula bandha* (anal lock), *kapalabhati* (rapid nostril breathing), and a deep relaxation technique for 2 hours per day for 21 days in 11 patients with MS who had neurogenic bladder dysfunction. The researchers found significant improvement in bladder function, thus supporting the safety and effectiveness of integrated yoga for bladder symptoms as an adjunct to standard care in MS.

In a systemic review of 11 mind–body studies, Senders, Wahbeh, Spain, and Shinto (2012) found that both yoga and mindfulness training improved symptoms of fatigue associated with MS, offering support with fewer side effects than conventional treatment. An intensive course of Ananda yoga followed by 17 weeks of home practice by 24 individuals with MS was found to have a positive impact on physical functioning and quality of life in mild to moderate MS (Salgado et al., 2013). In a recent study on 31 participants with MS, a thrice weekly course of treadmill training and hatha yoga classes for 2 months resulted in improved ambulatory function, fatigue, and mood status in the individuals with mild to moderate MS (Ahmadi, Arastoo, Nikbakht, Zahednejad, & Rajabpour, 2013). In an interesting study about attitudes toward complementary and alternative medicine among 119 Iranian women with MS, yoga was only practiced by women with higher education. Authors state that the cost of classes or lack of awareness about the existence of yoga as therapy among people with lower educational levels might be the reasons for absence of its use among people with lower educational levels (Harirchian, Sahraian, Hosseinkhani, & Amirzargar, 2014).

In order to investigate possible mechanisms responsible for improvements in symptoms of MS as a result of yoga practice, Morgan, Irwin, Chung, and Wang (2014) conducted a meta-analysis addressing CAM effects on the immunological system. They found at least five papers specifically on yoga and MS, which, although well controlled, included different populations. The authors investigated inflammatory parameters as well as immune responses to vaccination, and they concluded that yoga interventions may have positive effects by reducing markers of inflammation and optimizing virus-specific immune responses to vaccination. However, evidence is minimal and further investigations are proposed.

Since there are just a few papers about immunological diseases and yoga it is not possible to make any definitive conclusions about the possible role of yoga in this context.

Yoga and peripheral neuropathy

Peripheral neuropathy is associated with a large variety of conditions such as diabetes, alcoholism, nutrient deficiencies, heavy metal toxicity, infection, neurotoxic chemotherapy, human immunodeficiency virus (HIV)/antiretroviral drugs, and other etiologies and results in significant morbidity. Conventional pain medications that provide symptomatic relief have significant side effects and addiction profiles. However, a widening body of research indicates that alternative modalities such as yoga may offer significant benefit to this patient population (Head, 2006). Malhotra et al. (2002) studied the effect of yoga asanas on nerve conduction in type 2 diabetes. In an RCT of 40 individuals, half performed yoga asanas over a period of 40 days and the other half acted as controls; it was found that right-hand and left-hand median nerve conduction velocity increased in the yoga group and deteriorated in the control group, thus demonstrating the beneficial effect of yoga on nerve function in mild to moderate type 2 diabetes with subclinical neuropathy.

Carpal tunnel syndrome (CTS) is caused by the compression of the median nerve in the bones of the wrist joint. It is a common problem in the workplace and causes significant morbidity. In addition to its potentially debilitating physical aspects, CTS has a negative financial impact resulting from lost time from work and increasing medical expenses. Traditionally, CTS has been treated with wrist splints, anti-inflammatory agents, injection therapy, and surgery and occupationally by avoidance of exacerbating job duties or career changes. However, many of these options have provided less than satisfactory symptom relief (Pascarelli &

Quilter, 1994). In a single-blind RCT, Garfinkel et al. (1998) studied 42 individuals with CTS who received 8 weeks of hatha yoga sessions with a control group receiving a wrist splint. Participants in the yoga groups reported significant improvement in grip strength, pain reduction, and Phalen sign.

Conclusion

There is growing scientific interest in investigating the use and application of yoga as a complementary treatment for neurological and immune conditions (see Box 10.1). Indeed, the present chapter suggests overall that yoga may be a useful adjunct therapy for the rehabilitation of neurological diseases. The small number of RCTs indicates the broad spectrum of possible future investigations. New research could help elucidate the specificities of yoga modalities, the effective number and duration of sessions, and which kind of patient would gain most benefit from yoga interventions.

Although there are few RCTs addressing the effects of yoga for specific immunological disorders, many of them focus on multiple sclerosis, which may be benefited by yoga practice. Possible mechanisms for the immunomodulatory effects of yoga include reduced markers of inflammation and virus-specific responses to vaccination. Although the evidence is incomplete, these immunomodulatory effects warrant further rigorous methodologically controlled studies to determine the clinical implications of yoga for inflammatory and infectious disease outcomes.

Box 10.1 Effects and possible mechanisms through which yoga influences neurological conditions

Stroke

Yoga helps restore balance and decrease fear of falling and may have positive effects on aphasia. However, the level of evidence is still weak, and mechanisms must be further investigated.

Traumatic brain injury

Yoga may have positive effects on respiratory functioning and self-reported physical and psychological well-being. More research on individuals with traumatic brain injury is needed to determine the effects of yoga and determine the mechanisms involved.

Fibromyalgia

Yoga training leads to improvement in psychological, physical, and behavioral status, including alleviation of pain, fatigue, tiredness upon awakening, stiffness, tenderness, sleep problems, depression, memory, anxiety and an increase in global well-being; balance, vigor, strength, mindfulness, and overall functional status; better adaptive pain strategies, problem solving, acceptance, relaxation, and activity engagement; and decreased use of maladaptive strategies such as confrontation, self-isolation, disengagement, and catastrophizing. The body of evidence for the effects of yoga on fibromyalgia is growing, but the mechanisms by which yoga leads to these effects are still to be understood.

Autism spectrum disorder

Yoga increases self-esteem, emotional bonding, focus, tolerance to touch, proximity, sharing of attention, skills in eye contact, sitting tolerance, nonverbal communication and receptive skills to verbal commands related to spatial relationships, imitation, cognitive skills, and social-communicative behaviors, in addition to reducing maladaptative classroom behavior and improving family relationships. Possible mechanisms for these effects of yoga practice are increase of brain GABA levels and mirror neuron activation through teacher observation.

Headache

Through relaxation, yoga decreases electromyography amplitude of facial muscles and decreases headache intensity and frequency. Possible mechanisms are a decrease in sympathetic and increase in parasympathetic nervous system activity with consequent improvement in autonomic modulation and improved vascular function (endothelium) as expressed by increased vascular cell adhesion molecules. The body of evidence is consistent.

Alzheimer's disease

Yoga training improves both physical and mental (cognitive) health of patients with Alzheimer's disease. Yoga leads to a decrease in behavior problems and depression, better sustained and selective attention, and an increase in set-shifting tasks performance, immediate and delayed recall of verbal and visual memory, attention and working memory, verbal fluency, executive function, and processing speed. The mechanisms have not been addressed in controlled studies.

Parkinson's disease

Yoga may increase functional activities, muscle length and strength, and dynamic balance. The body of evidence is poor and no mechanism has been addressed.

Neurological and immune disorders

In patients with MS, yoga helps symptom management, improves general well-being and physical and ambulatory function (balance, mobility, flexibility, spasticity, and muscle strength), and mood and quality of life; it decreases fatigue, physical pain, and depression and improves selective attention, cognitive function, and neurogenic bladder management. Although sparsely investigated, mechanisms may include reduced markers of inflammation and optimized immune system.

Peripheral neuropathy

Yoga training may have beneficial effects on BMI, glycemic control, oxidative stress, and nerve function (increased median nerve conduction velocity) in subclinical diabetic neuropathy. Patients with carpal tunnel syndrome benefit from yoga on grip strength, pain and Phalen sign reduction. Mechanisms must be addressed in further controlled investigations.

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Neurological and Immune Conditions: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Leigh Blashki says, “Fibromyalgia brings considerable emotional stress for sufferers. Because of a lack of a particular injury, illness, or other causative factor, sufferers often carry ‘labeling’ of the pain being imaginary or in other ways invalid. This, combined with the debilitating pain itself, can often lead to low mood states and a tendency to disengage from normal life activities and relationships. Therefore, it is important that clients with these conditions be made to feel heard, validated, and encouraged. Providing them with very short, simple practices allows them to feel more empowered, as they can usually manage these basic practices.”

”Physiologically it is believed that the chronic pain is a result of a disruption to the normal pain-signaling mechanisms,” Blashki says, “whereby pain is registered in the absence of a stimulus that would lead to pain. I have found that regular, short bouts of low-intensity movement create a temporary break in the pain cycle. Some physical therapists believe this may result from the activity of the motor neurons overriding the afferent pain signals at the interneurons. The key is very short, easy bouts of practice a number of times during the day, which over time may disrupt the ‘disruption’ and allows for a normalizing of the pain response.”

Blashki has students do simple asanas that take them through spinal flexion, extension, lateral flexion, and rotation, using a single posture or movement for each, tied to the breath. Here’s an example of a pose he might use for severe cases, to be done seated on a chair: “Sit toward the front of the chair and bring knees close together. Place the left hand over the right knee and the right hand on the small of the back. Inhaling, sit up tall and on exhale gently rotate the torso to the right, letting the head follow the rotation. On inhale, return to starting position and move to the other side, then repeat.” In addition, he encourages students to include deep relaxation with *yoga nidra* or another guided relaxation technique, and, eventually, to start a regular meditation practice.

Carrie Demers says, “The theory of hypersensitivity of the nervous system in fibromyalgia syndrome (FMS), rendering normally nonpainful stimuli painful, is consistent with the ayurvedic view of vata excess. The prominence of pain and symptom variability are other hallmarks of vata disease.” She has found that relaxation practices and breathing practices that calm and soothe an overactive autonomic nervous system and which reduce vata “should be the primary prescription for FMS patients.” In addition, she has recommended other vata-pacification strategies such as massaging oil onto the body, eating high-quality dietary fats, and establishing a regular daily routine.

The most effective relaxation technique Demers has found is a guided meditation technique called “61

Points.” After the student has developed some facility with smooth, diaphragmatic breathing, she has them come into corpse pose. Then the student brings attention to each of the 61 points throughout the body, one by one, as the teacher or audio recording lists them, from the third eye (between the eyebrows) to the limbs and back. “I tell my patients, ‘Wherever we bring our mind and breath, we bring prana’—and that prana is healing.”

Scott Blossom says that in various neurodegenerative disorders, the combination of high vata and low *ojas* in the nerve pathways (*majja vaha srotas*) “is the most common ayurvedic pattern. This has biological implications for cognitive function, efferent and afferent nervous function, and autonomic nervous system imbalance.” He warns that “people with these kind of diseases have to be careful with any practices that exhaust them, especially excessive vinyasa yoga–type practices.” He also strives to help them “to establish a vata-friendly lifestyle, which is primarily characterized by rhythm and routine in eating, sleeping, and exercise routines.”

Blossom often recommends “standing balancing postures that are not strenuous such as *vrkshasana* ” (tree pose), either supported by a wall or free-standing. He has also had good results with supine postures like bridge pose, revolved abdomen pose, and supported corpse pose. He says, “Regulating the breath into very precise rhythms is very helpful.” He recommends extending the exhalation for students with agitation and extending the inhalation for those with exhaustion.

”Methods for pain management,” Gary Kraftsow says, “vary depending on the causes and the symptoms, and as well the nature of the individual suffering from pain." He says, "Yoga therapy is very effective in managing physiological as well as psychosocial symptoms of pain, including fatigue, stress, sleep issues, functional loss, fear and anxiety, depression and sense of loss, low self-esteem, and social isolation." In general with patients in pain, he tends to recommend an energizing breath-centered practice in the morning to work with fatigue that results from pain and lack of sleep. He recommends a second short daily practice in the evening, also focused on the breath but this one more calming "to support relaxation and sleep when working with stress and anxiety as a result of pain."

Kraftsow says that musculoskeletal (tension) headaches "can often be managed by adapted asana to release chronic muscular contraction," followed by a calming pranayama practice. "Sinus headaches are often helped by *sitali pranayama* with alternate-nostril exhale plus short suspension of the breath after exhale." *Sitali* is a cooling breath in which one inhales through a rolled tongue and exhales through the nose. "Hormonal headaches are often helped by dietary adjustments and *nadi sodhana pranayama* [altenate-nostril breathing] for balancing. Vascular headaches (including migraine and cluster types and headaches related to elevated blood pressure), he says, "are sometimes reduced by alternate-nostril inhalation pranayama, palming the eyes or placing a cool cloth over the eyes, and guided relaxation or meditation."

Figure 10.1 A, B

Strategically placed sandbags can make restorative yoga poses more grounding.

Photographs by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Matthew Sandford says, “There is a general tendency for people living with spinal cord injuries to ‘live’ from their point of injury up. For example, people paralyzed from the chest down often only truly identify with only their upper bodies. This results in a profound lack of grounding; a failure to pay adequate attention to the lower extremities; less pressure sore awareness; a sunken chest and consequently extra wear and tear on shoulders and rotator cuffs; a tendency to be more violent with their paralyzed body; being more prone to frustration and anger; and a general lack of wholeness, both psychologically and emotionally, but also in coordinated, full-bodied movement."

"Emphasize anything that enhances a sense of grounding in yoga poses," Sandford says, "for example, the use of sandbags in poses *upavista konasana* , on the ankles, s*upta padangustasana,* on the down leg, and on the shoulders in *Savasana* (see Fig. 10.1A). I highly recommend passive chest opening of all kinds, especially lying with a bolster down the length of the spine. This could be combined with putting sandbags on thighs" (see Fig. 10.1B).

Sandford suggests that yoga be presented "as full-bodied movement, regardless of the level of paralysis." He says, "Coordinate shifts in body position and thus the experience of gravity with breath and movement. Do not be afraid to instruct students to activate awareness through their paralyzed body by saying things like 'do it even if you can't.' The strategy is to get their mind working to connect through the whole body by whatever means possible."

Resources

Book: *Yoga for Wellness* by Gary Kraftsow

Book: *Yoga for Pain Relief* by Kelly McGonigal

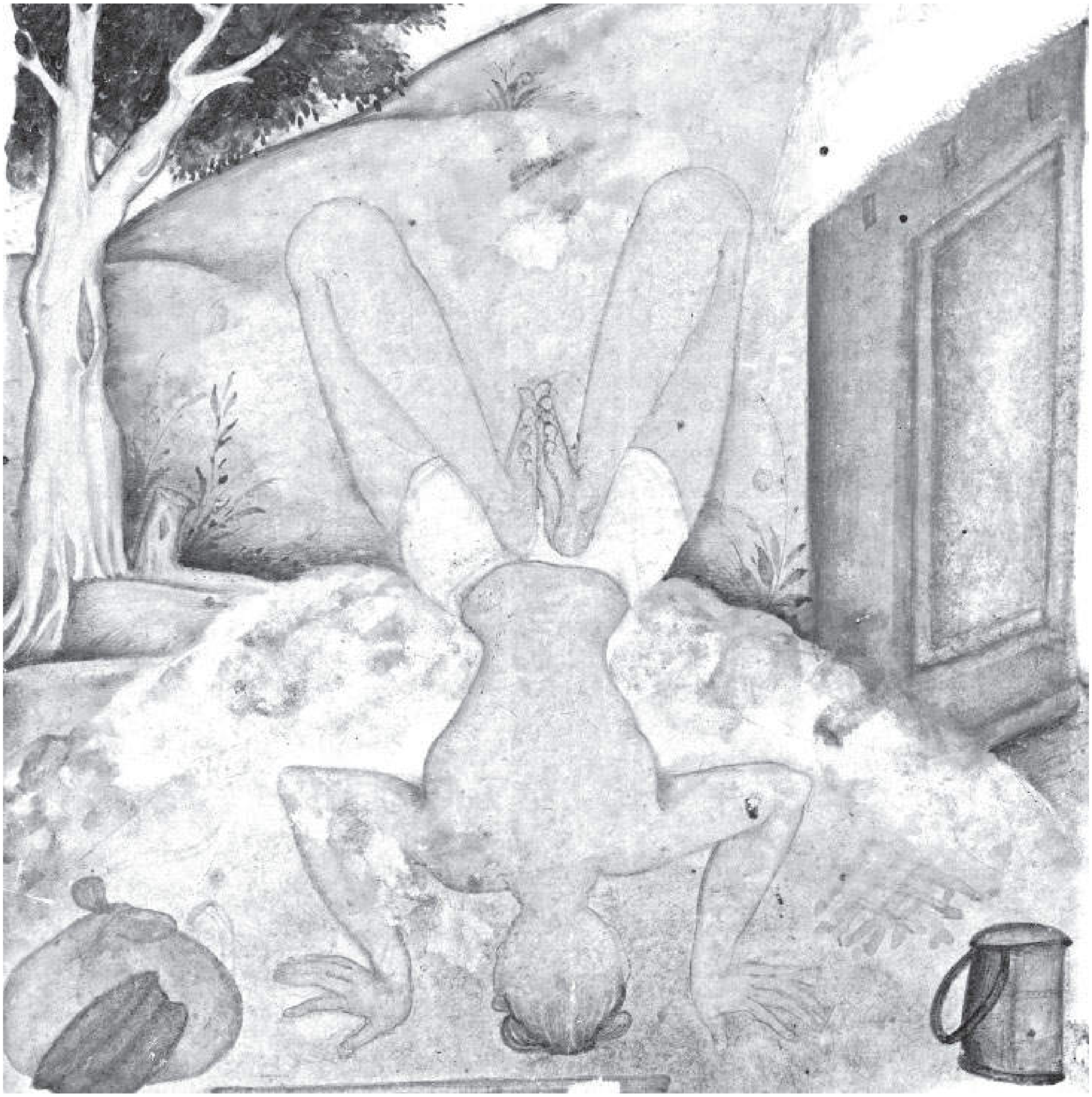
Audio: *Advanced Yoga Relaxations* by Rolf Sovik

Video: *Beyond Disability* by Matthew Sanford

Video: *Transforming Disability* by Matthew Sanford

SECTION 4

ENDOCRINE CONDITIONS



From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.20a. © The Trustees of the Chester Beatty Library, Ireland.

CHAPTER ELEVEN

YOGA THERAPY FOR DIABETES

KE INNES • TK SELFE • FM HECHT

Introduction

Type 2 diabetes mellitus: pathophysiology, etiology, and prevalence

An estimated 22 million people in the United States, including one-fifth of adults aged 65 and older, have type 2 diabetes mellitus (T2DM), and the prevalence is increasing (Danaei et al., 2011). T2DM significantly increases risk for both microvascular complications, such as retinopathy, diabetic neuropathy, and kidney disease, and macrovascular complications such as atherosclerosis, stroke, and myocardial infarction. T2DM is also linked to elevated risk for other chronic conditions, including depression, chronic liver disease, and dementia (American Diabetes Association, 2014; Inzucchi et al., 2012). Cardiovascular disease (CVD) is the primary cause of death in those with T2DM (Joseph & Golden, 2014). The health, social, and economic consequences of T2DM are substantial. Ten percent of healthcare dollars in the United States are spent on T2DM, making it the single most costly chronic disease nationwide (Petersen & American Diabetes Association, 2013). T2DM has become a leading public health issue worldwide, with an estimated 366 million people affected in 2011 (Lam & LeRoith, 2012), representing an over twofold rise in the last three decades. This increase parallels the growing pandemic of obesity and the increasingly widespread adoption of Western lifestyles (Chen, Magliano, & Zimmet, 2012; Lam & LeRoith, 2012). Global prevalence is expected to continue rising in both industrialized and developing countries (Chen et al., 2012; Inzucchi et al., 2012), with numbers projected to reach 552 million adults by 2030 (Lam & LeRoith, 2012).

The central feature characterizing T2DM is hyperglycemia in the setting of insulin resistance, in contrast to type 1 diabetes mellitus (T1DM), in which the central feature is insulin deficiency (American Diabetes Association, 2014). Other key related metabolic and hemodynamic abnormalities typifying T2DM include dyslipidemia, elevated blood pressure, and chronic inflammation, as well as increased oxidative stress and hypercoagulation (Fowler, 2011; Innes & Vincent, 2007). The prevalence of T2DM rises with increasing age and is further elevated in certain ethnic and racial groups, including Asians, non-Hispanic blacks, Pacific Islanders, and Native Americans (Yoon et al., 2006; Zimmet, Shaw, Murray, & Sicree, 2003). However, although age, race, genetic predisposition, and other nonmodifiable factors contribute to the risk of developing T2DM, the current global T2DM epidemic is thought to be fueled largely by lifestyle factors, in particular, physical inactivity and overnutrition, and related obesity (Hu, 2011; Lam & LeRoith, 2012). Other contributing lifestyle-related factors include impaired sleep, depression, chronic stress, and smoking (Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Chen et al., 2012; Innes & Vincent, 2007; Nouwen et al., 2010). In fact, lifestyle factors may account for at least 90% of new onset cases of T2DM (Chen et al., 2012), and are significant predictors of diabetes-related complications and premature mortality (Lin et al., 2012). Lifestyle management is thus a central element of T2DM care, and is considered critical to the prevention of acute complications and reducing risk for long-term complications (American Diabetes Association, 2014).

A major priority in the management of T2DM is reduction of blood glucose levels, which has been shown to reduce risk of microvascular and possibly other complications (American Diabetes Association, 2014; Fowler, 2011; Inzucchi et al., 2012). However, although improving glycemic control remains a central goal, T2DM management has increasingly addressed multiple risk factors for complications, reflecting the complex constellation of factors that underlie the development of T2DM and its sequelae (American Diabetes Association, 2014; Inzucchi et al., 2012). Importantly, reducing risk factors for CVD, the leading cause of morbidity and mortality in T2DM (Joseph & Golden, 2014), is critical to effective T2DM management (American Diabetes Association, 2014). Additional goals include alleviating depression, reducing T2DM-related distress, and enhancing emotional well-being and quality of life, factors that are important predictors of treatment adherence, glycemic control, complication rates, and other outcomes (American Diabetes Association, 2014; Beverly, 2014; Safren et al., 2014).

Given the escalating costs of care, identifying sustainable, low-cost lifestyle interventions with the potential to improve multiple indices of relevance to the management of this complex chronic illness is of clear importance. Of particular interest in this regard are active mind–body therapies such as yoga. A growing body of evidence suggests yoga practice may reduce risk for CVD and lead to improvements in physical health and well-being in a range of populations (Bussing, Michalsen, Khalsa, Telles, & Sherman, 2012; Cramer, Lauche et al., 2014; Ross & Thomas, 2010), potentially including those with T2DM.

In this chapter, we briefly discuss possible mechanisms by which yoga may affect risk factors for T2DM and critically evaluate available evidence from the published scientific literature regarding the effects of yoga-based programs on health-related outcomes in adults with T2DM. We also outline major limitations in the current literature, detail directions for future research, and briefly discuss the clinical relevance of the findings.

Psychophysiological rationale for the use of yoga for T2DM

Although the mechanisms underlying the apparent beneficial effects of yoga therapy on T2DM risk profiles are not yet well understood, mechanistic pathways are likely complex and interacting. The observed changes may occur through at least four pathways, as depicted in Figure 11.1 (Hansen & Innes, 2013).

First, yoga may lessen the negative impact of stress and promote multiple positive downstream effects on metabolic function, neuroendocrine status, and related inflammatory responses, and yoga may, ultimately, reduce risk for CVD and other vascular complications by enhancing well-being and reducing reactivity and activation of the hypothalamic pituitary adrenal (HPA) axis and the sympathoadrenal system (Fig. 11.1 , pathway 1).

Second, yoga practices may shift the autonomic nervous system balance from sympathetic to parasympathetic, possibly via vagal stimulation. Increased parasympathetic activation can result in positive changes in cardiovagal function and associated neuroendocrine, hemodynamic, and inflammatory profiles; in sleep and affect; and in related downstream metabolic parameters (Fig. 11.1 , pathway 2). These factors have been strongly linked to increased risk for T2DM, as well as CVD (Hansen & Innes, 2013).

Third, yoga may selectively activate specific brain structures and neurochemical systems related to attention and positive affect (Fig. 11.1 , pathway 3), as suggested by recent neurophysiological and neuroimaging research findings (Innes & Selfe, 2014). This in turn can promote favorable changes in autonomic balance, memory and mood, neurological structure and function, and in related metabolic and inflammatory responses.

And fourth, yoga practices may improve both metabolic and psychological risk profiles, support increased physical activity, enhance neuroendocrine function, improve body composition, and promote weight loss by increasing strength, overall fitness, and physical function (Fig. 11.1 , pathway 4). In addition, yoga may benefit those with T2DM by encouraging improvements in health-related attitudes and behaviors (Alexander, Innes, Selfe, & Brown, 2013; Dittmann & Freedman, 2009), and by providing a source of social support, a factor linked to improved diabetes self-care and clinical outcomes (van Dam et al., 2005).

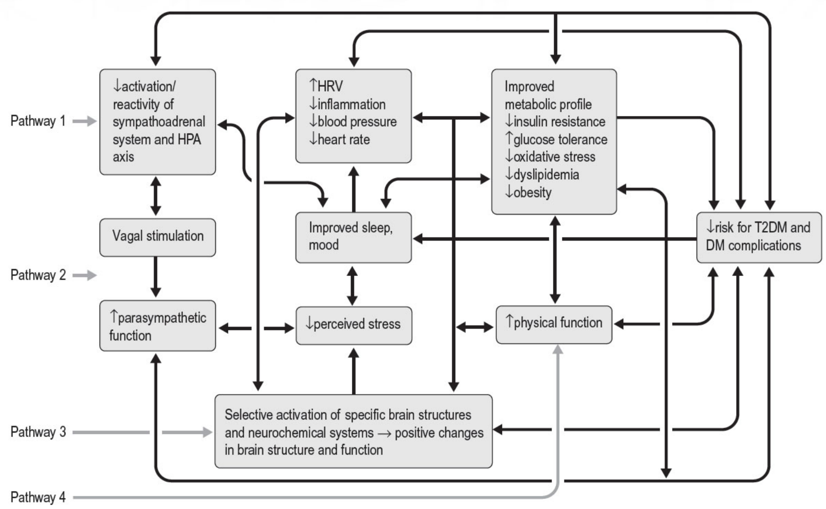


Figure 11.1
Some pathways by which yoga practices may influence outcomes in those with and at risk for type 2 diabetes.
Reproduced with permission from Hansen & Innes, 2013

Review of published literature

Methods

We conducted a search of the published scientific literature to identify studies regarding the effects of yoga in adults with T2DM. The search was restricted to articles published in peer-reviewed scientific journals and to original studies specifically evaluating the effects of yoga (alone or in combination with other interventions) on metabolic, anthropometric, or clinical profiles of adults with T2DM. Original studies were included in the review if they reported quantitative outcome data from controlled trials and evaluated the effects of yoga and yoga-based interventions on measures of glycemic control and insulin resistance, lipid profiles, body weight or composition, blood pressure, oxidative stress, or nervous system function. We excluded studies that did not involve an intervention focused on yoga as the major component and studies of less than two weeks' duration; we also excluded uncontrolled trials, cross-sectional studies, case series and case studies, and any trials that were published only in dissertation or abstract form. Because the etiology of and management for T1DM differs from that for T2DM, studies targeting populations with T1DM were also excluded.

We categorized clinical measures and outcomes evaluated into several domains. For each domain, we summarized findings from relevant studies. In our discussion of findings, we also considered recent meta-analyses of randomized controlled trials targeting populations with diabetes.

Results

A total of 28 papers reporting findings from 23 original studies, including 12 randomized controlled trials (RCTs) and 11 nonrandomized controlled trials (NRCTs), representing a total of 2000 enrolled participants, met our eligibility criteria and are discussed in this chapter.

Of the 23 studies, 22 (96%) specified adults with T2DM; in the remaining investigation, participants were recruited from a diabetes clinic, but authors did not specify type of diabetes (Table 11.1 , p. 220). Most (78%) were moderate-sized studies that included over 40 participants, 39% included 61 or more participants, and 7 (30%) included at least 100 participants. The vast majority of the studies, 78%, were conducted in India. All but two were published in 2000 or later, with 57% published in the last 5 years. Yoga interventions ranged from 15 days (Subramaniyan, Subramaniyan, & Chidambaram, 2012) to 12 months (Céspedes, Riverón, Alonso, & Gordon, 2002) in duration, with 74% including at least 12 weeks of yoga practice (Table 11.1 , p. 220). Programs varied substantially in content, as well as in frequency and intensity of practice. For example, interventions varied from a 3-month hatha yoga program in which participants attended one to two classes per week (Skoro-Kondza, Tai, Gadelrab, Drincevic, & Greenhalgh, 2009); a 90-day program of daily deep yoga relaxation practice (yoga nidra) (Amita, Prabhakar, Manoj, Harminder, & Pavan, 2009); and a 6-month Sudarshan Kriya (SKY) rhythmic breathing program, with classes once a week and daily home practice (Jyotsna, Ambekar, Joshi, Dhawan, Kumar, & Gupta, 2012); to 3- to 12-month comprehensive yoga programs with practice 6–7 days per week (Nagarathna et al., 2012). In all but two studies (91%), the yoga programs incorporated active asanas. Comparator conditions also varied widely, from waitlist (Skoro-Kondza, Tai, Gadelrab, Drincevic, Greenhalgh, 2009), usual care (Agrawal et al., 2003; Agte & Tarwadi, 2004; Amita et al., 2009; Bindra, Nair, & Darotiya, 2013; Dash & Thakur, 2014; Gordon et al., 2008b; Habibi & Marandi, 2014; Hegde et al., 2011; Jyotsna et al., 2012; Jyotsna, Ambekar, Singla, Joshi, Dhawan, & Kumar, 2013; Kyizom, Singh, Singh, Tandon, & Kumar, 2010; Malhotra et al., 2010; Malhotra et al., 2002; Monro, Power, Coumar, & Dandona, 1992; Pardasany, Shenoy, & Sandhu, 2010; Shantakumari, Sequeira, & El deeb, 2013; Singh, Kyizom, Singh, Tandon, & Madhu, 2008; Skoro-Kondza et al., 2009), and/or group education (Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012), to a comprehensive conventional exercise program (Céspedes et al., 2002; Gordon et al., 2008b; Nagarathna et al., 2012; Subramaniyan et al., 2012). Three studies included more than one comparator group (Gordon et al., 2008b; Khare & Jain, 1999; Pardasany et al., 2010). For some studies, usual care included only medications (Agrawal et al., 2003; Agte & Tarwadi, 2004; Amita et al., 2009; Bindra et al., 2013; Pardasany et al., 2010; Shantakumari et al., 2013; Singh et al., 2008), whereas in others, standard care also included walking or other exercise (Jyotsna et al., 2012, 2013; Jyotsna et al., 2013; Malhotra et al., 2010; Malhotra et al., 2002; Singh et al., 2008) and/or a special diet (Dash & Thakur, 2014; Jyotsna et al., 2012, 2013; Khare & Jain, 1999; Malhotra et al., 2010; Malhotra et al., 2002; Monro et al., 1992).

Effects of yoga on metabolic, hemodynamic, and anthropometric indices

Twenty-three eligible studies investigated the potential influence of yoga-based programs on one or more physiologic or anthropometric indices of relevance to diabetes management and prognosis, including measures of glucose tolerance and insulin resistance, lipid profiles, blood pressure, and body weight and composition. Findings of these studies are summarized in Tables 11.2 and 11.3 (pp. 222, 230) and are discussed briefly below.

Measures of glucose tolerance and insulin resistance

Twenty-two studies evaluated the effects of yoga on markers of glucose tolerance and insulin resistance, with all but two documenting significant, postintervention improvement in one or more measures following the practice of yoga either alone or in combination with other therapies (Table 11.3 , p. 230). Interventions ranged in length from 15 days (Subramaniyan et al., 2012) to 12 months (Céspedes et al., 2002), and all but two (Amita et al., 2009; Viveka P. Jyotsna et al., 2012) incorporated active yoga asanas. Of the 12 RCTs assessing the effects of yoga-based programs on measures of glycemia and insulin resistance (*N* = 1040 participants), 10 reported significant improvements in at least one index (Tables 11.2 and 11.3 , pp. 222, 230). Beneficial changes reported included significant declines in fasting blood glucose (FBG) (Amita et al., 2009; Gordon et al., 2008b; Habibi & Marandi, 2014; Monro et al., 1992; Pardasany et al., 2010; Shantakumari, Sequeira, & Eldeeba, 2012; Subramaniyan et al., 2012; Vaishali et al., 2012), postprandial blood glucose (PPBG) (Amita et al., 2009; Jyotsna et al., 2012; Jyotsna, Dhawan, Sreenivas, Deepak, & Singla, 2014; Pardasany et al., 2010), glycated hemoglobin (HbA1c) (Gordon et al., 2008b; Monro et al., 1992; Vaishali et al., 2012), and insulin (Habibi & Marandi, 2014) in those assigned to a yoga-based program versus usual care, group education, or brisk walking. Two additional studies observed significant reductions in FBG, PPBG, and HbA1c following a comprehensive yoga program that were similar to those observed in participants assigned to a relatively intensive exercise intervention (Gordon et al., 2008a; Nagarathna et al., 2012).

In contrast, two RCTs (Céspedes et al., 2002; Skoro-Kondza et al., 2009) reported no significant changes in these parameters. In a small 12-month Cuban study of 40 patients with uncomplicated T2DM, participants assigned to the yoga group showed modest declines in FBG (7%) that did not differ significantly from those of the exercise group (1.7%) (C**é** spedes et al., 2002). However, in these trials, participants demonstrated significant beneficial changes in other risk indices (Tables 11.2 and 11.3 , pp. 222, 230). In contrast, a UK trial of 59 adults with T2DM showed no significant improvements either in glucose control or in other major endpoints (Skoro-Kondza et al., 2009), findings that may be in part attributable to the poor participant adherence in this study (50% class attendance and 0% performance of home practice).

Of the 10 NRCTs (total *N* = 920 participants), all observed significant improvement in one of more indices of glycemia/insulin resistance. Reported improvements again included reductions in FBG (Agrawal et al., 2003; Agte & Tarwadi, 2004; Balaji, Varne, & Ali, 2011; Bindra et al., 2013; Dash & Thakur, 2014; Hegde et al., 2011; Khare & Jain, 1999; Kyizom et al., 2010; Malhotra et al., 2010; Singh et al., 2008), PPBG (Agte & Tarwadi, 2004; Balaji et al., 2011; Dash & Thakur, 2014; Hegde et al., 2011; Kyizom et al., 2010; Singh et al., 2008), HbA1c (Agrawal et al., 2003; Balaji et al., 2011; Bindra et al., 2013; Dash & Thakur, 2014; Hegde et al., 2011), fasting insulin (Singh et al., 2008), and fructosamine (Khare & Jain, 1999) among participants completing a yoga-based intervention compared to controls receiving usual care, standard care with light exercise, or a low-fat vegetarian diet alone.

Collectively, 91% of the 22 controlled studies conducted to date, including 10 of the 12 RCTs and 10 out of 10 NRCTs, reported improvements in glucose control with yogic practice that were clinically as well as statistically significant, suggesting that yogic practices may improve glucose control in adults with T2DM. However, nine studies: three RCTs (Amita et al., 2009; Pardasany et al., 2010; Subramaniyan et al., 2012) and six NRCTs (Agte & Tarwadi, 2004; Balaji et al., 2011; Khare & Jain, 1999; Kyizom et al., 2010; Malhotra et al., 2010; Singh et al., 2008), did not report between-group comparisons and, as discussed below, most suffered methodologic or other limitations, further hindering interpretation of findings. Magnitude of effects varied substantially among trials, from relatively modest improvements to very large effects depending on the study population, design, and comparator group (Table 11.3 , p. 230). For example, in a Cuban RCT of 231 adults with uncomplicated T2DM (Gordon et al., 2008b), participants who completed a comprehensive 24-week yoga program showed dramatic declines in FBG at 3 and 6 months (27.5% and 29.5%, respectively) that were comparable to those participating in an intensive 24-week conventional exercise program (25.8% and 27.4%) and significantly greater than the participants assigned to usual care (9% and 7%) (Fig. 11.2 , p. 222). By contrast, in a small RCT of British adults with T2DM, Monro and colleagues (Monro et al., 1992) reported a more modest decline in FBG (10.8 mg/dL, or 7%) among participants attending structured yoga classes that was nonetheless significantly greater than that of usual care controls, who experienced a pronounced rise in fasting glucose (21.6 ng/dL) during this same period.

Lipid profiles

Of the 23 controlled trials included in this review, 16 (1,575 total participants) assessed the effects of yogic practices on lipid profiles in adults with T2DM; of these, all but one trial (Skoro-Kondza et al., 2009) documented significant improvement in one or more lipid indices (Tables 11.2 and 11.3 , pp. 222, 230). Studies varied in duration from 40 days (Dash & Thakur, 2014) to 12 months (Céspedes et al., 2002), and all incorporated active yoga asanas; in all except one trial (Skoro-Kondza et al., 2009), participants assigned to the yoga intervention practiced at least 3 days/week. As indicated in Tables 11.2 and 11.3 (pp. 222, 230), seven of the eight RCTs (totaling 838 participants) reported significant beneficial changes in lipid profiles following completion of a yoga-based program. These included significant declines in total cholesterol (Céspedes et al., 2002; Gordon et al., 2008b; Pardasany et al., 2010; Shantakumari et al., 2013; Vaishali et al., 2012), low-density lipoprotein cholesterol (LDL) (Céspedes et al., 2002; Nagarathna et al., 2012; Pardasany et al., 2010; Shantakumari et al., 2013; Vaishali et al., 2012), and triglycerides (Céspedes et al., 2002; Habibi & Marandi, 2014; N. Shantakumari et al., 2013; Vaishali et al., 2012) and significant increases in high-density lipoprotein cholesterol (HDL) (Céspedes et al., 2002; Gordon et al., 2008b; Nagarathna et al., 2012; Pardasany et al., 2010; Shantakumari et al., 2013; Vaishali et al., 2012) relative to usual care, group education, or a moderate-intensity exercise program. Only one study, an RCT of 59 British adults, reported no significant change in lipid profiles following the 12-week yoga program (Skoro-Kondza et al., 2009), findings, again, likely in part attributable to poor participant compliance.

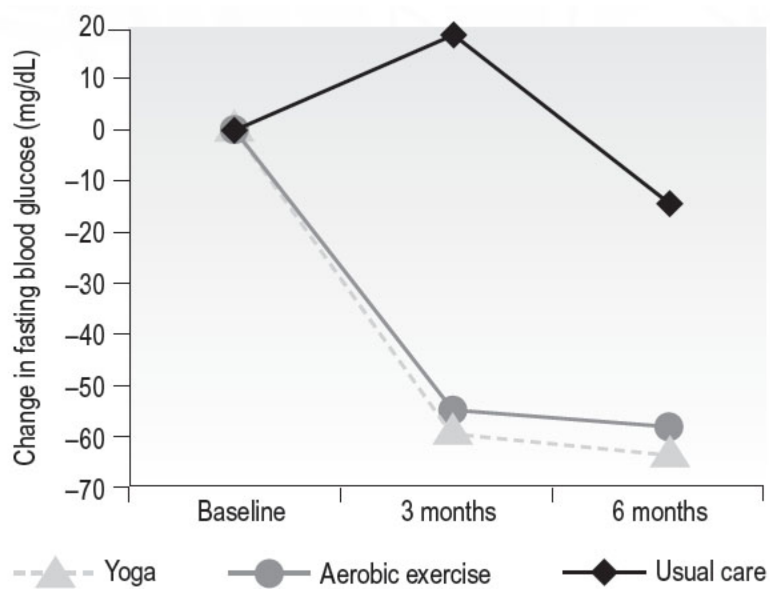


Figure 11.2
Effects of yoga on blood glucose (RCT, *N* = 231 adults with T2DM).
Adapted from Gordon et al., 2008

Similarly, all eight NRCTs (*N* = 737 participants) reported significant improvements in serum lipids, including reductions in total cholesterol, LDL, very low-density lipoprotein cholesterol (VLDL), and triglycerides and increases in HDL relative to usual care (Agrawal et al., 2003; Agte & Tarwadi, 2004; Balaji et al., 2011; Bindra et al., 2013; Dash & Thakur, 2014; Khare & Jain, 1999; Singh et al., 2008), or usual care with light exercise (Malhotra et al., 2010).

Overall, 94% of the controlled trials reviewed reported beneficial changes in lipid profiles following completion of yoga programs of varying duration and intensity. Again, reported improvements were clinically as well as statistically significant, with magnitude of changes varying substantially with the study and target population (Table 11.3 , p. 230). For example, relative to usual care or education, declines in total cholesterol ranged from 5% in two trials of Indian adults (Bindra et al., 2013; Vaishali et al., 2012) to 18.3% in an RCT of Cuban patients (Gordon et al., 2008b); similarly, reductions in triglycerides varied from 4.2% (Bindra et al., 2013) to 17.2% (Agrawal et al., 2003) to 28.9% (Shantakumari et al., 2013). Notably, these declines with yoga were comparable to or greater than those observed following a moderate-intensity conventional exercise program (Céspedes et al., 2002; Gordon et al., 2008b; Nagarathna et al., 2012). For example, in an RCT of 277 Indian adults with uncomplicated T2DM, participants assigned to a 9-month yoga program showed a 5% greater increase in HDL and an 11.4% greater reduction in LDL than did those completing a 9-month comprehensive exercise program, differences that were highly significant (see Fig. 11.3 , p. 230) (Nagarathna et al., 2012); yoga group participants also demonstrated a 16.3% greater decline in VLDL than did those in the conventional exercise group, although this difference did not reach statistical significance. Declines with yoga relative to usual care were particularly pronounced in some studies; for example, in a study of 200 Indian adults (of whom 154 completed the trial), participants assigned to a 3-month yogic lifestyle program showed a 25% greater increase in serum HDL, a 17% greater decline in triglycerides, and a 15% greater reduction in LDL than did the usual care group (Agrawal et al., 2003). However, again, interpretation of findings is hindered by failure of several studies to present between-group comparisons, as well as by the other design and methodological limitations characterizing many of the studies and discussed in more detail below.

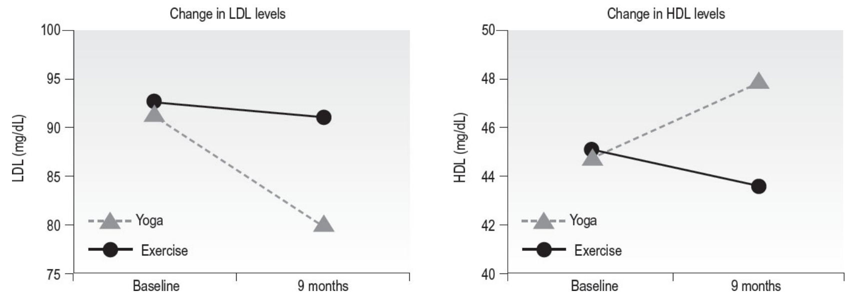


Figure 11.3
Effects of yoga on lipid profiles (RCT, *N* = 277 adults with type 2 diabetes.
Adapted from Nagarathna et al., 2012

Body weight and composition

A total of nine controlled trials examined the potential effects of yoga on weight and body composition in adults with T2DM, including three RCTs and six NRCTs; again, all but one study (Skoro-Kondza et al., 2009) (89%) reported beneficial changes in those assigned to a yoga intervention. Trials ranged in length from 40 days (Malhotra et al., 2010) to 6 months (Gordon et al., 2008b), all included active asanas in the yoga program, and in all but the one trial reporting no significant improvements (Skoro-Kondza et al., 2009), participants practiced at least three times per week. Two of the three RCTs (*N* = 390 total participants), including a 3-month study of 100 Indian adults (Shantakumari et al., 2013) and a 6-month study in 231 Cuban adults (Gordon et al., 2008b), reported significant reductions in weight (Shantakumari et al., 2013), body mass index (BMI) (Gordon et al., 2008b), and waist–hip ratio (Shantakumari et al., 2013) in participants assigned to a yoga program versus usual care; observed improvements with yoga were, again, comparable to those observed following a moderate intensity physical activity program (Gordon et al., 2008b). In contrast, a British RCT of 59 adults reported no significant improvement in weight or BMI relative to usual care (Skoro-Kondza et al., 2009), although no data were presented, and participant adherence in this study was low, limiting interpretation of findings.

Findings of the six NRCTs (*N* = 613 total participants) also suggest overall beneficial effects of yoga on these parameters, although results vary by study design and population (Table 11.2 , p. 222). All reported significant improvements in at least one measure of body size and composition, including reductions in body weight (Balaji et al., 2011; Khare & Jain, 1999; Singh et al., 2008), BMI (Agrawal et al., 2003; Balaji et al., 2011; Hegde et al., 2011; Singh et al., 2008) and waist–hip ratio (Agrawal et al., 2003; Balaji et al., 2011; Malhotra et al., 2010) relative to usual care or standard care and light exercise.

Blood pressure

We identified only five controlled trials targeting adults with T2DM that evaluated the potential influence of yoga on blood pressure, including two RCTs and three NRCTs (N = total of 588 participants). Trials ranged from 40 days to 3 months in duration, and all included active asanas. One exploratory RCT of 59 British adults (Skoro-Kondza et al., 2009) reported no significant changes following a 12-week versus usual care program, but did not present any quantitative data on blood pressure. Three of the five studies, one RCT (N. Shantakumari et al., 2012) and two NRCTs (Agrawal et al., 2003; Malhotra et al., 2010) in Indian adults showed significant drops in systolic and diastolic blood pressure relative to usual care (Agrawal et al., 2003; N. Shantakumari et al., 2012) or usual care combined with walking (Malhotra et al., 2010). Another Indian study of 123 adults (Hegde et al., 2011) showed similar declines in blood pressure in participants assigned to the yoga versus the usual care group, but differences were not statistically significant.

In summary, findings of these studies collectively suggest that yoga may have significant beneficial effects on multiple risk indices important in the management of T2DM, including glycemic control, insulin resistance, lipid profiles, body weight and composition, and, possibly, blood pressure. These findings are further supported by recently published meta-analyses regarding the effects of yoga on specific CVD risk factors of relevance to T2DM, detailed in Table 11.4 (p. 232) (Cramer, Haller et al., 2014; Cramer, Lauche et al., 2014; Hagins, States, Selfe, & Innes, 2013). For example, in subanalyses restricted to RCTs in adults with T2DM, Cramer et al. reported greater average reductions of 26 mg/dL in FBG and 0.5% in HbA1c; greater mean declines of 13 mg/dL in total cholesterol, 10 mg/dL in LDL, 5 mg/dL in VLDL, and 24 mg/dL in triglyceride levels; and a higher average increase of 6 mg/dL in HDL in participants assigned to a yoga versus usual care group (Cramer, Lauche et al., 2014). Notably, the authors also found significantly greater declines in LDL (9 mg/dL) and higher increases in HDL levels (4 mg/dL) in the yoga versus conventional exercise group. Likewise, Cramer et al. also reported greater mean reductions in waist–hip ratio in participants with T2DM assigned to a yoga versus a usual care group (Cramer, Lauche et al., 2014). Although studies regarding the effects of yoga on blood pressure in adults with T2DM remain few, recent meta-analyses regarding the effects of yoga in other populations at risk for CVD suggest that yoga may be beneficial for regulating blood pressure in patients with diabetes as well. For example, in subanalyses of RCTs limited to eight trials of adults without frank diabetes but at high risk of T2DM and CVD (e.g., those with obesity, impaired glucose tolerance, or metabolic syndrome), the authors noted significant mean declines of 10 mmHg in systolic blood pressure and 7.5 mmHg in diastolic blood pressure in participants receiving a yoga intervention versus usual care (Cramer, Lauche et al., 2014). Meta-analyses of controlled trials in adults with hypertension have yielded similar findings (Cramer, Haller et al., 2014; Hagins et al., 2013), indicating significant declines of 8–10 mmHg in systolic blood pressure and 6–7 mmHg in diastolic blood pressure in the yoga versus usual care groups (Table 11.4 , p. 232).

Effects of yoga on other relevant indices

There is mounting evidence that yoga may improve other risk indices relevant to the management of T2DM as well, including oxidative stress, autonomic nervous system function, medication use, and impairments in mood and sleep.

Oxidative stress, an imbalance between tissue free radicals, reactive oxygen species (ROS), and antioxidants, has been strongly implicated in the development of T2DM and diabetes-related complications (Vincent, Innes, & Vincent, 2007). To date, at least four controlled trials have examined the effects of yoga on measures of oxidative stress in adults with T2DM. Yoga interventions ranged from 40 days to 6 months; all incorporated active asanas in the yoga intervention, and all indicated beneficial changes with yoga (Table 11.2 , p. 222). For example, an RCT of 231 Cuban adults, those assigned to a 24-week yoga program showed reductions in malondialdehyde (MDA), an estimate of lipid oxidative damage, and increases in activity of the antioxidant superoxide dismutase (SOD) that were greater than participants assigned to usual care and comparable to those completing a 24-week conventional exercise program (Gordon et al., 2008b). Three NRCTs in Indian adults likewise documented improvements in indices of oxidative balance; these included significant declines in MDA (Agte & Tarwadi, 2004; Hegde et al., 2011; Malhotra et al., 2010) among participants completing a 40-day (Malhotra et al., 2010) to 4-month yoga program (Agte & Tarwadi, 2004) versus those assigned to usual care (Agte & Tarwadi, 2004; Hegde et al., 2011) or usual care with light exercise (Malhotra et al., 2010); in their 3-month study of 123 adults, Hegde et al. also reported significantly greater increases in serum levels of the antioxidants glutathione and vitamin C in the yoga versus usual care group (Hegde et al., 2011).

Autonomic nervous system dysfunction has been implicated in the development of diabetes (Carnethon et al., 2006) and associated with increased risk for morbidity and mortality in those with T2DM (Maser, Mitchell, Vinik, & Freeman, 2003). Although over 30 controlled studies (17 RCTs) have examined the effect of yoga on markers of autonomic function (Innes, Bourguignon, & Taylor, 2005), our search identified only two that targeted adults with T2DM, both conducted in India. These include an RCT of SKY yoga in adults enrolled in a diabetes lifestyle-modification program that included daily brisk walking (Viveka P. Jyotsna et al., 2012; Viveka P. Jyotsna et al., 2013), and an NRT (Malhotra et al., 2010) assessing the effects of a 40-day comprehensive yoga intervention (Malhotra et al., 2010) (Table 11.2 , p. 222). Relative to controls receiving usual care (Viveka P. Jyotsna et al., 2012) or usual care combined with exercise (Malhotra et al., 2010), participants who completed a pranayama program showed significant reductions in heart rate (Malhotra et al., 2010) and significant improvements in multiple indices of cardiac autonomic function (Viveka P. Jyotsna et al., 2012; Malhotra et al., 2010). These findings suggest that yoga practices may promote a shift in autonomic nervous system balance from primarily sympathetic to parasympathetic in adults with T2DM.

Mood and sleep impairment are common comorbid conditions in individuals with T2DM and are strongly related, in a bidirectional manner, to the development and progression of T2DM (Cappuccio et al., 2010; Nouwen et al., 2010). However, few controlled trials have assessed the effects of yoga on these endpoints in populations with T2DM.

Our search identified only four that specifically evaluated indices of psychological status, including three RCTs (Amita et al., 2009; Viveka P. Jyotsna et al., 2012; V. P. Jyotsna et al., 2014; Skoro-Kondza et al., 2009) and one NRCT (Agrawal et al., 2003); in three of the four trials, authors reported significant beneficial changes with yogic practices (Table 11.2 , p. 222). These included improvement in multiple domains of quality of life (Agrawal et al., 2003; Viveka P. Jyotsna et al., 2012; V. P. Jyotsna et al., 2014), as well as in measures of psychological well-being (Agrawal et al., 2003) and reported symptoms of distress (Amita et al., 2009). Data regarding the effects of yoga on sleep in adults with diabetes are even fewer. We were able to identify only one controlled trial of T2DM patients that has examined the effects of yoga on any measure of sleep impairment; in this RCT of 41 Indian adults, prevalence of insomnia decreased from 43% to 5% among participants completing a program of daily yoga nidra (a deep relaxation yoga practice) (Amita et al., 2009).

Medication use: Three controlled trials to date (one RCT (Nagarathna et al., 2012), two NRCTs (Agrawal et al., 2003; Balaji et al., 2011)) have shown significant reductions in use of diabetes medications in patients completing a 3-month (Agrawal et al., 2003; Balaji et al., 2011) to 9-month (Nagarathna et al., 2012) yoga program relative to those assigned to usual care (Agrawal et al., 2003; Balaji et al., 2011) or a comprehensive exercise program (Nagarathna et al., 2012). Some of these declines were quite substantial. For example, in their trial of 154 adults with diabetes, Agrawal et al. reported reductions in medication use of 26% to 40% in the yoga group at the 3-month follow-up (Agrawal et al., 2003).

Study limitations and directions for future research

Despite the clear promise of yoga as a therapeutic intervention for T2DM, many studies continue to suffer from methodological problems, poor reporting, and other limitations that hinder interpretation of findings and preclude firm conclusions. While study sample size has been increasing overall in the last decade, most of the controlled trials conducted to date remain relatively small, with 20% of existing trials including 40 or fewer participants and 56% including 60 or less (Table 11.1 , p. 220). Importantly, participants were not assigned randomly to treatment in 11 of the 23 controlled studies, increasing risk for selection bias, and treatment allocation procedures were specifically described in only 3 (Nagarathna et al., 2012; Skoro-Kondza et al., 2009; Vaishali et al., 2012) of the 23 trials. Among the 12 RCTs, only 2 (Nagarathna et al., 2012; Skoro-Kondza et al., 2009) specified how randomization was performed. Likewise, blinded outcome assessment was specifically addressed in only two trials (Nagarathna et al., 2012; Skoro-Kondza et al., 2009), raising the possibility of information bias. Retention was not always reported and varied widely (from 60% to 100%), and reasons for dropout were rarely specified. Only five studies included specific data on participant adherence (Gordon et al., 2008a; Hegde et al., 2011; Jyotsna et al., 2012; Monro et al., 1992; Skoro-Kondza et al., 2009), and even in these studies, adherence was highly variable, ranging from excellent (Gordon et al., 2008a; Hegde et al., 2011) to very poor (Skoro-Kondza et al., 2009); moreover, for one study (Jyotsna et al., 2014), adherence data were reported for only a subset of participants (Jyotsna et al., 2012). In many articles, the study population, participant recruitment, comparator condition, and/or yoga-based intervention were poorly described, rendering replication of these studies challenging and limiting conclusions. In some papers, details regarding analytical methods were sparse, analyses were inadequate, and/or data were incompletely or confusingly presented. For example, although all studies reviewed included a comparator group, between-group comparisons were not presented in 10 of the 23 studies, including three RCTs. In addition, the substantial heterogeneity in study design, population, duration, comparator condition, and intervention characterizing the 23 trials also renders comparison across studies difficult. Studies regarding the effects of yoga on sleep and psychological status, often compromised in T2DM and significant contributors to diabetes progression and prognosis, remain sparse, as do those regarding the effects of yoga programs on clinical outcomes in T2DM and on certain emerging risk factors, including proinflammatory markers. Relatively few studies have been conducted in Western countries, where T2DM is now reaching epidemic proportions, and effective management remains challenging. Importantly, long-term follow-up studies are also lacking, as are rigorous dosing and cost-effectiveness studies. And, as indicated earlier, the mechanisms underlying the observed benefits of yoga remain poorly understood. Finally, the data available to date focus on surrogate measures for clinical endpoints such as diabetic complications and mortality. While some of the measures, such as HbA1c, blood pressure, body weight, and lipid levels, are important clinically (American Diabetes Association, 2014; Fowler, 2011), improvements do not always translate directly into changes in patient outcomes (Wieczorek, Rys, Skrzekowska-Baran, & Malecki, 2008). To truly determine the clinical significance of interventions such as yoga in management of T2DM, longer-term large-scale studies are needed, but are challenging and expensive to perform.

Conclusions

The collective findings of controlled trials to date indicate that yoga may promote clinically significant improvements in several indices of central importance in T2DM management. These include glycemic control, lipid levels, and weight and body composition. More limited data suggest that yoga may also lower blood pressure and oxidative stress; reduce sympathetic activation and improve nervous system function; enhance mood, sleep, and quality of life; and decrease medication use in those with T2DM. These studies suggest that yoga could play an important role as a low-cost intervention to improve T2DM management. Given the methodological limitations of the existing research, however, additional rigorous investigations are clearly needed to confirm and further elucidate the potential therapeutic benefits of standardized yoga programs in populations with T2DM.

Table 11.1 Characteristics of eligible studies investigating the effects of yoga-based programs in adults with diabetes (*N* : 23 controlled trials, including 12 randomized and 11 nonrandomized controlled trials)

Target population: adults with:	**Nonrandomized controlled trials (*N*)**	**Randomized controlled trials (*N*)**	**Total** *N*	**%**
Type 2 diabetes only	10	12	22	95.7%
Unspecified diabetes	1	0	1	4.3%
Sample size				
< 25	0	2	2	8.7%
25–40	1	2	3	13.0%
41–60	4	4	8	34.8%
> 60	6	4	10	43.5%
Location				
India	11	7	18	78.3%
United Kingdom	0	2	2	8.7%
Cuba	0	2	2	8.7%
Iran	0	1	1	4.3%
Year published				
2010–2014	6	7	13	56.5%
2005–2009	1	3	4	17.4%
2000–2004	3	1	4	17.4%
Prior to 2000	1	1	4	8.7%
Yoga intervention * **Yoga-based program alone**				
Including asanas	9	10	19	82.6%
Not including asanas	0	2	2	8.7%
Yoga combined with other interventions				
Including asanas	3	0	3	13.0%
Not including asanas	0	0	0	0.0%
Duration				
< 8 weeks	5	1	6	26.1%
12 weeks/3 months	5	7	12	52.2%
4–6 months	1	2	3	13.0%
> 6 months	0	2	2	8.7%
Frequency of practice †				
< 3 ×/week	0	1	1	4.8%
3 ×/week	1	3	4	19.0%
4–5 ×/week	1	1	2	9.5%
6–7 ×/week	7	7	14	66.7%
Program structure ††				

Classes only	9	7	16	72.7%
Classes combined with home practice	0	5	5	22.7%
Training session combined with home practice	1	0	1	4.5%
Comparison condition **				
Usual care/no treatment	9	8	17	73.9%
Attention control	0	1	1	4.3%
Active comparator	3	5	8	34.8%
> 1 Control	1	2	3	13.0%

*Including two yoga-based interventions tested within same study (Khare & Jain, 1999).

†Practice frequency not specified in two NRCTs (nonrandomized controlled trials) (Agte & Tarwadi, 2004; Bindra, Nair, & Darotiya, 2013).

††Information on program structure lacking for one NRCT (Bindra, Nair, & Darotiya, 2013).

**Numbers add up to more than 23, because 3 studies included more than one comparator.

Table 11.2 Summary of study characteristics and major findings					
First author, year, location	**Tx duration, design**	**Study population**	***N* enrolled/completed (per grp) [% retention]**	**Yoga intervention**	**Compariso condition**
Randomized controlled trials					
Habibi, 2014, Iran (Habibi & Marandi, 2014)	12 weeks	Women w/T2DM	26 (16 Y, 10 C) [100%]ŧ	Yoga: 75 min, 3 d/wk	Usual care
Jyotsna, 2014, India (Jyotsna et al., 2012a; Jyotsna et al., 2013; Jyotsna, Dhawan, Sreenivas, Deepak, & Singla, 2014; Jyotsna et al., 2012b)	6 months	Adults w/T2DM plus: lifestyle modification, A1c of 6–9%, and oral hypoglycemic agents for past 6 months; Mean age (yrs): 49.92 ± 11.46 (yoga), 47.25 ± 10.80 (control); A1c: 7.06 ± 0.98 (Y), 7.08 ± 0.91 (C)	120 (64 Y, 56 C) [100%]ŧ	Sudarshan Kriya Yoga (SKY: a rhythmic cyclical breathing, preceded by PR); 3-day group training program followed by classes 1 ×/wk (long kriya) and daily home practice (short kriya) + standard care	Standard ca (oral antidiabetic drugs and d and exercise advice)
Shantakumari, 2013, India (Shantakumari, Sequeira, & El deeb, 2013) 2013 (Shantakumari, Sequeira, & Eldeeba, 2012)	3 months	Outpts with T2DM, avg 45 y; 48% F	100 (50 Y, 50 C) [100%]ŧ	Yoga: 1 hr daily; AS (30–35 min), PR (10 min), and M (15 min); + usual care	Usual care (oral hypoglycem drugs, no yoga)
Nagarathna, 2012, India (Nagarathna et al., 2012)	9 months	Pts > 25 yo with T2DM > 1 yr (FBG > 120 mg% when dx), stable dose of oral hypoglycemic agents or insulin for at least 3 wks, no prior yoga practice, no major complications; Mean age: 52.4 y; 31% F	277 (141 Y, 136 C)/173 (88 Y, 85 C) [62%]	Yoga (AS, PR, M, devotional sessions, lectures): 1 hr/d, 5 d/wk for 12 weeks [cleansing techniques (kriyas) performed 1 ×/wk]; one 2-hr class/wk and 1-hr daily home practice for 9 mos	Exercises ar walking designed to achieve a comparable intensity of physical exertion, nonyogic breathing exercises, supine rest, and lectures 1 hr/d, 5 d/w for 12 week one 2-hr class/wk and 1-hr daily home practi for 9 mos
Subramaniyan, 2012, India	15 days	Males ≥ 18 yo w/T2DM on	20 [100%]ŧ	Yoga: 60 min (6–7 a.m.)	Brisk walkin 60 min (6–7

(Subramaniyan, Subramaniyan, & Chidambaram, 2012)		usual care and medically eligible for walking/yoga per physician; Age: 55% were 31–40 yo; 25% had DM for < 1 yr; 50% had FBG 151–200 mg/dL		daily; AS (~30 min), sun salutation (~6 min), SH (~25 min)	a.m.) daily
Vaishali, 2012, India (Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)	12 weeks	Diabetic clinic pts, > 60 yo, w/T2DM > 15 years and ≥ 1 metabolic risk factor (high FBG, pre-HTN, overwt/obese, high TC)	60/57 [95%]	Yoga (individualized AS, PR, SH): 45–60 min under supervision, 6 d/wk	Educational group (general healthy lifestyle and exercise): 1 ×/mo.
Pardasany, 2010, India (Pardasany, Shenoy, & Sandhu, 2010)	12 weeks, 3-arm	Adults w/T2DM, age 40–60 y; excluded: history of any type of renal disease in the past, arthritis, HBP, intermittent claudication, diabetic foot, foot injury or ulcers, breathlessness, any form of cardiac disease; 38% F	45 (15, 15, 15) [100%]ŧ	1. Hatha yoga (12 AS and 6/7 PR); 3 ×/week* 2. Yang-style tai chi (24 forms): 3 ×/week* All taking oral hypoglycemic meds	Oral hypoglycem meds, no exercise
Amita, 2009, India (Amita, Prabhakar, Manoj, Harminder, & Pavan, 2009)	Up to 90 days	Middle-aged (35–65 yo), T2DM pts on oral hypoglycemics; 29% F	41 (20 Y, 21 C) [100%]ŧ	Yoga nidra ("... a state of relaxation and awareness on the border between sleep and wakefulness, allowing contact with the subconscious unconscious mind..."): 45 min, daily	Usual care (yoga)
Skoro-Kondza, 2009, UK (London) (Skoro-Kondza, Tai, Gadelrab, Drincevic, & Greenhalgh, 2009)	12 weeks	Adults (> 18 yo) w/T2DM, not on insulin; most well-controlled (A1c × = 6.9); mean duration of T2DM (y): 30 ± 5; mean age	59 [100%]ŧ*	Yoga (PR, AS, SH): 90-min class, 3 ×/wk	Waitlist (bot groups give leaflets on healthy lifestyle and encouraged exercise)

		(y): 60 ± 10; non-white: 55% at one site, 40% at other site; 61% F			
Gordon, 2008ab, Cuba (Gordon, et al., 2008a; Gordon et al., 2008b)	24 weeks, age- and sex-matched controls	Pts 40–70 y w/T2DM from 1–10 yrs, with at least 3 mos of DM education, no severe complications, nonsmoker, non-alcoholic	231 (77 pts: 62 females, 15 males per group) [100%]ŧ***	Yoga: PR (20 min), warm-up exercises (25 min), AS (60 min), and SH (15 min); 1 class/wk for 24 wks plus home exercise	1. PT: warm-up exercises (15 min), aerobic walking (30 min), flexibility exercises (2 min), aerobi dance (20 min), games (25 min), warm-down (10 min); 1 class/w for 2 wks plus home exercise 3–4 ×/w; 2. Control: followed tx plan as recommend by their doctors, no active exercise tx during study
Céspedes, 2002, Cuba (Céspedes, Riverón, Alonso, & Gordon, 2002)	12 months	T2DM patients, 50–70 y, DM duration 2–5 y, without malnutrition or severe complications, in good mental health	40 (22 Y, 18 C) [100%]ŧ	Moderate-intensity yoga (PR, AS): 60-min class, 3 ×/wk + lifestyle advice, soybean-rich diet	Moderate-intensity aerobic exercise: 60 min class, 3 ×/wk + lifestyle advice, soybean-ricl diet
Monro, 1992, UK (Monro, Power, Coumar, & Dandona, 1992)	12 weeks	NIDDM controlled with meds (*N* = 13; yoga group = 8) or diet (*N* = 8); excluded: end-stage liver or kidney disease or congestive cardiac failure; age (y): 45–67, mean: 53 ± 6 (Y), 57 ± 7.3 (C)	21 (11 Y, 10 C) [100%]**	Yoga (PR, AS, R) + usual care: 90-min classes offered 5 ×/wk (most attended class 1–2 ×/wk and practiced at home 1–2 ×/wk)	Usual care (continue or medication, diet)
Nonrandomized controlled trials					
Dash, 2014,	40 days	Adults (40–60	60 (30 Y, 30 C)	Yoga (AS, PR,	Prescribed

India (Dash & Thakur, 2014)		yo) w/T2DM for 0–10 yrs; excluded: BMI > 25; DM1; T2DM w/nephropathy, CAD, or retinopathy; alcoholic; practicing any yoga; 37% F	[100%]ŧ	SH, M): 30–40 min/day; + prescribed diet, oral meds	diet, oral meds
Bindra, 2013, India (Bindra, Nair, & Darotiya, 2013)	Up to 90 days	Adults 35–65 y w/DM2 for not > 10 yrs and no complications; excluded: those w/RA, cancer, TB, MI, not willing to do yoga	100 (50 Y, 50 C) [100%]ŧ	Yoga (not described) + oral DM meds	Oral DM me only
Balaji, 2011, India (Balaji, Varne, & Ali, 2011)	3 months	Uncomplicated T2DM pts 40–55 yo w/DM duration 1–10 yrs	44 (22 Y, 22 C) [100%]ŧ	Yoga (AS, PR, SH): daily for 1 hr; Subgroup T1 (*n* = 16): + oral drugs; Subgroup T2 (*n* = 6): + oral drugs & insulin	Standard ca (including meds)
Hegde, 2011, India (Hegde et al., 2011)	3 months	DM clinic pts w/T2DM; Age (y): 40–75, mean 59.8 ± 9.9 (Y), 57.5 ± 8.9 (C); nonsmoking, no alcoholics.	123/120 (60 Y, 63 C); strat'd by complications [98%]***	Yoga (AS, PR, SH): at least 3d/wk; + usual care	Usual care (given gene oral and written information about diet and exercise
Kyizom, 2010, India (Kyizom, Singh, Singh, Tandon, & Kumar, 2010)	45 days; groups matched for age and sex	DM clinic pts, 35–60 yo, w/uncomplicated T2DM from 2–10 yrs; Mean DM duration (y) = 4.38 ± 1.98 (Y), 4.16 ± 1.86 (C)	60 (30 Y, 30 C) [100%]ŧ	Yoga (AS, PR, SH): daily for 45 min/d; + usual care	Standard ca
Malhotra, 2010, India (Malhotra et al., 2010)	40 days; controls matched on age and DM severity	Pts from Endocrine Metabolic clinic w/T2DM for 0–10 y, 30–60 y, on recommended diet and oral DM meds; Excluded:	106 (56 Y, 50 C)/64 (26 Y, 38 C) [60%]	Yoga (AS, PR, SH): 40–60 min/d; + diet and DM meds	Usual care: meds, diet, and light exercises (walking)

		CAD, nephropathy, and proliferative retinopathy			
Singh, 2008, India (Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	45 days	Pts 35–60 yo, w/uncomplicated T2DM for 1–10 y	60 (30 Y, 30 C) [100%]ŧ	Yoga (AS, PR, SH): daily for 45 min/d; + usual care	Usual care (convention meds)
Agte, 2004, India (Agte & Tarwadi, 2004)	4 months	Previously diagnosed T2DM pts 45–65 yo of both genders; had stabilized glucose levels, and taking conventional prescribed medications; Age: 54.6 ± 11.8 (Y), 55.7 ± 5.8 (C); BMI: 25.4 ± 3.7 (Y), 25.6 ± 4.3 (C); 53% F	87 (57 Y, 30 C)/65 (35 Y, 30 C) [75%]	SKY plus PR, AS, and M; interactive discussions on stress-free living; nutritional counseling w/emphasis on eating fresh fruits and vegetables; 6 d course	Without SKY training
Agrawal, 2003, India (Agrawal et al., 2003)	3 months	Pts randomly selected from diabetes clinic (type of DM not specified, but background implies that study targeted T2DM); excluded pts w/liver disease, alcoholism, malnutrition, thyrotoxicosis, TB, or who were non-cooperative	200/154 (82 Y, 72 C) [77%]	Yogic lifestyle program: health rejuvenation exercises (5 min), AS (18 min), abdominal exercises (7 min), and R/M/PR (30 min); at least 5 d/w + diet	Standard medical tx c usual home exercise program
Malhotra, 2002, India (Malhotra et al., 2002)	40 days; controls matched on age, sex, SES, and DM severity	T2DM for 0–10 y; 30–60 yo; Excluded: cardiac, renal, and proliferative retinal complications	40 (20 Y, 20 C) [100%]ŧ	Supervised yoga (AS, PR, SH): daily for 30–40 min/d; + medication, diet	Medication, diet, light exercise (walking)

Khare, 1999, India (Khare & Jain, 1999)	3 months, non-DM controls matched for age, sex	60 NIDDM pts (DM for 1–2 yrs) from DM clinics (in yoga/diet groups), 20 non-DM matched on age, sex; 40–70 y on vegetarian diet	80 (20, 20, 20, 20) [100%]ɫ	1. Yoga: AS (3 poses, 2–5 min ea) and SH (20 min) only 2. Yoga + strict diet Yoga: 2 ×/d	1. No intervention (non-DM adults) 2. Strict diet alone (20 DI adults)

ɫAssumed (retention not specifically reported); *Adherence very low; **Adherence moderate; ***Adherence excellent.

A1c: glycated hemoglobin A1c; AHA: An
avg: average; BF: biofeedback; BP: bloo
artery disease; CAFT: cardiac autonomic
composition; d: day, DM: diabetes melli
expiratory value in first second; FVC: fo
lipoprotein; HR: heart rate; HTN: hypert
innate and adaptive immunity against v
control; IR: insulin resistance (markers o
mass; LDL: low density lipoprotein; M: n
program; MDA: malondialdehyde; MI: m
ventilation; PEFR: peak expiratory flow r
relaxation; POX: protein oxidation; PPBG
breathing exercises; QOL: quality of life
arthritis; Resid: residential; SH: shavasa
SNS/PNS: markers of sympathetic/paras
catecholamine levels; SOD: superoxide
total cholesterol; Tg: triglycerides; veg:
waist–hip ratio; wk: week; wt: weight; y:

Table 11.3 Observed percent change with yoga in metabolic indices, body weight, and blood pressure among adults with type 2 diabetes (N : 23 controlled) trials, stratified by study design and analytic comparisons presented (pre–post, intergroup). Only studies reporting significant changes included

	Study design			
	Nonrandomized controlled trials		**Randomized controlled trials**	
Findings, by clinical measure	**Yoga vs. baseline**	**Yoga vs. controls**	**Yoga vs. baseline**	**Yoga vs. controls**
Measures of insulin resistance				
Fasting glucose	17.36–33.23% (Agte & Tarwadi, 2004; Balaji, Varne, & Ali, 2011; Dash & Thakur, 2014; Khare & Jain, 1999; Kyizom, Singh, Singh, Tandon, & Kumar, 2010; Malhotra et al., 2010; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	9.87–29.75% (Agrawal et al., 2003; Bindra, Nair, & Darotiya, 2013; Dash & Thakur, 2014; Hegde et al., 2011)	7.21–27.53% (Amita, Prabhakar, Manoj, Harminder, & Pavan, 2009; Gordon et al., 2008b; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu, 2010; Subramaniyan, Subramaniyan, & Chidambaram, 2012)	13.46–36.2% (Gordon et al., 2008b; Habibi & Marandi, 2014; Monro, Power, Coumar, & Dandona, 1992; Pardasany, Shenoy, & Sandhu, 2010; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
Postprandial glucose	5.92–38.65% (Agte & Tarwadi, 2004; Balaji, Varne, & Ali, 2011; Dash & Thakur, 2014; Kyizom, Singh, Singh, Tandon, & Kumar, 2010; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	11.61–35.5% (Dash & Thakur, 2014; Hegde et al., 2011)	7.03–18.89% (Amita, Prabhakar, Manoj, Harminder, & Pavan, 2009; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu, 2010)	11.17–14.22% (Jyotsna et al., 2012a; Pardasany, Shenoy, & Sandhu, 2010)
Fasting glycated hemoglobin (HbA1c)	1.55–21.23% (Balaji, Varne, & Ali, 2011; Dash & Thakur, 2014)	1.03–7.44% (Agrawal et al., 2003; Bindra, Nair, & Darotiya, 2013); Dash & Thakur, 2014; Hegde et al., 2011)	0.31–14.17% (Gordon et al., 2008a; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu, 2010)	7.77–17.78% (Gordon et al., 2008a; Monro, Power, Coumar, & Dandona, 1992; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
Blood lipid profiles				
Total cholesterol	5.97–14.61% (Agte & Tarwadi, 2004; Dash & Thakur, 2014; Khare & Jain, 1999; Malhotra et al., 2010; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	4.11–8.63% (Agrawal et al., 2003; Bindra, Nair, & Darotiya,	1.37–37.01% (Céspedes, Riverón, Alonso, & Gordon, 2002; Gordon et al., 2008b; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu,	4.74–18.3% (Céspedes, Riverón, Alonso, & Gordon, 2002; Gordon et al., 2008b; Pardasany, Shenoy, & Sandhu,

		2013; Dash & Thakur, 2014)	2010; Shantakumari, Sequeira, & El deeb, 2013)	2010; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
Triglycerides	3.97–16.35% (Agte & Tarwadi, 2004; Balaji, Varne, & Ali, 2011; Dash & Thakur, 2014; Malhotra et al., 2010; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	3.53% (Dash & Thakur, 2014)	14.33–38.0% (Céspedes, Riverón, Alonso, & Gordon, 2002; Nagarathna et al., 2012; Shantakumari, Sequeira, & El deeb, 2013)	1.06–10.96% (Céspedes, Riverón, Alonso, & Gordon, 2002; Habibi & Marandi, 2014; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
Low-density lipoprotein (LDL)	2.18–14.88% (Balaji, Varne, & Ali, 2011; Dash & Thakur, 2014; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	1.38–15.05% (Agrawal et al., 2003; Bindra, Nair, & Darotiya, 2013; Dash & Thakur, 2014)	8.33–48.45% (Céspedes, Riverón, Alonso, & Gordon, 2002; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu, 2010) (Shantakumari, Sequeira, & El deeb, 2013)	3.39–11.42% (Céspedes, Riverón, Alonso, & Gordon, 2002; Nagarathna et al., 2012; Pardasany, Shenoy, & Sandhu, 2010; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
High-density lipoprotein (HDL)	8.28–15.21% (Dash & Thakur, 2014; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	5.01–24.96% (Agrawal et al., 2003; Bindra, Nair, & Darotiya, 2013; Dash & Thakur, 2014)	6.99–101.59% (Céspedes, Riverón, Alonso, & Gordon, 2002; Nagarathna et al., 2012)	9.1–54.92% (Céspedes, Riverón, Alonso, & Gordon, 2002; Nagarathna et al., 2012; Vaishali, Kumar, Adhikari, & UnniKrishnan, 2012)
Very-low-density lipoprotein (VLDL)	15.17–16.06% (Dash & Thakur, 2014; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)	13.28% (Agrawal et al., 2003)	7.23–22.66% (Gordon et al., 2008b; Nagarathna et al., 2012)	
Anthropometric measures				
BMI	7.52–10.34% (Balaji, Varne, & Ali, 2011)	2.72–3.56% (Agrawal et al., 2003; Hegde et al., 2011)		4.32% (Gordon et al., 2008a)
Body weight	3.48–6.95% (Balaji, Varne, & Ali, 2011; Khare & Jain, 1999; Singh, Kyizom, Singh, Tandon, & Madhu, 2008)			4.18% (Shantakumari, Sequeira, & El deeb, 2013)
Waist–hip circumference ratio	5.38–8.99% (Balaji, Varne, & Ali, 2011; Malhotra et al., 2010)		3.17% (Agrawal et al., 2003)	5.32% (Shantakumari,

				Sequeira, & El deeb, 2013)
Blood pressure				
Systolic blood pressure	11.27% (Malhotra et al., 2010)	5.03% (Agrawal et al., 2003)		
Diastolic blood pressure	12.92% (Malhotra et al., 2010)	3.46% (Agrawal et al., 2003)		

Table 11.4 Recent published meta-analyses regarding effects of yoga on risk indices relevant to T2DM: Summarized findings

		Included studies					Mean Difference	
Measure	**First author, year**	**Population**	**Design**	**No.**	**Total Pts**	**Comparator**	**(95% CI)**	***P***
Glucose tolerance								
Fasting blood glucose (mg/dL)	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	7	525	Usual care	-25.56 (-39.60, -11.53)	< 0.01
HbA1c	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	7	550	Usual care	-0.49 (-1.03, 0.05)	0.07
Lipid profiles								
Total cholesterol	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	5	516	Usual care	-13.09 (-19.60, -6.59)	< 0.01
	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	317	Exercise	-8.08 (-19.20, 3.03)	0.21
HDL	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	5	516	Usual care	5.51 (3.56, 7.47)	< 0.01
	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	317	Exercise	4.24 (1.75, 6.72)	0.01
LDL	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	5	515	Usual care	-10.26 (-20.85, 0.32)	0.06
	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	317	Exercise	-9.24 (-16.55, -1.93)	0.01
VLDL	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	308	Usual care	-4.81 (-6.67, -2.96)	< 0.01
Triglycerides	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	5	509	Usual care	-23.60 (-36.78, -10.43)	< 0.01
	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	317	Exercise	-22.98 (-60.97, 15.00)	0.24
Body composition								

Waist–Hip ratio	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	3	311	Usual care	-0.02 (-0.03, -0.00)	< 0.01
Blood pressure (BP)								
Systolic BP (mmHg)	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	3	237	Usual care	-6.87 (-14.68, 0.94)	0.08
	Cramer, 2014a (Cramer et al. 2014b)	Non-DM high risk	RCTs	8	347	Usual care	-10.00 (-16.42, -3.59)	< 0.01
	Cramer, 2014b (Cramer et al., 2014a)	HT	RCTs	6	278	Usual care	-9.65 (-17.66, -2.06)	0.01
	Hagins, 2013 (Hagins, States, Selfe, & Innes, 2013)	HT (all)	RCTs, NRCTs	11	431	Usual care	−7.96 (-10.65, -5.27)	0.0002
	Hagins, 2013 (Hagins, States, Selfe, & Innes, 2013)	HT (Y incl M, PR, AS)	RCTs, NRCTs	13	656	All	-8.17 (-12.45, -3.89)	NR
	Hagins, 2013 (Hagins, States, Selfe, & Innes, 2013)	HT (Y > 58.9 h)	RCTs, NRCTs	6	215	All	-9.73 (-17.66, -1.79)	NR
Diastolic BP (mmHg)	Cramer, 2014a (Cramer et al., 2014b)	T2 DM	RCTs	2	210	Usual care	-0.79 (-5.22, 3.65)	0.73
	Cramer, 2014a (Cramer et al., 2014b)	Non-DM high risk	RCTs	8	347	Usual care	-7.45 (-12.70, -2.21)	< 0.01
	Cramer, 2014a (Cramer et al., 2014a)	HT	RCTs	6	278	Usual care	-7.22 (-12.83, -1.62)	0.01
	Hagins, 2013 (Hagins, States, Selfe, & Innes, 2013)	HT (all)	RCTs, NRCTs	11	431	Usual care	-6.14 (-9.39, -2.89)	NR
	Hagins, 2013 (Hagins, States, Selfe, & Innes, 2013)	HT (Y incl M, PR, AS)	RCTs, NRCTs	13	656	All	-5.52 (-7.92, -3.11)	NR

Autonomic function								
Heart rate	Cramer, 2014a (Cramer et al., 2014b)	Non-DM high risk	RCTs	3	133	Usual care	-10.89 (-22.83, 1.04)	0.07*

AS: asana; CI: confidence interval; h: hour; NR: not reported; NRCT: nonrandomized controlled trial; PR: pranayama; Pts: participants; RCT: randomized controlled trial; T2 DM: type 2 diabetes mellitus; Y: yoga.

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DIABETES: CLINICAL INSIGHTS

TIMOTHY MC CALL IN COLLABORATION WITH THE CONSULTING YOGA TEACHERS AND YOGA THERAPISTS

Classically, in the yoga tradition, asanas that work the region of the upper and central abdomen are felt to be useful in diabetes, Ganesh Mohan says, particularly when emphasizing the exhalation and the hold after exhalation. "I would base the exertion level of the practice on the fitness of the individual. Starting with breath awareness and comfortable breathing, I would introduce focus on the exhalation in the practice." Following, in such practices as "down dog, *tadaga mudra* [lying on the back with arms raised], and modified shoulderstand, suspension of breath after exhalation can be introduced. I might also introduce some simple *uddiyana bandha* [upward abdominal lock] in these three postures if the person is able to do it."

Scott Blossom reports that viewed ayurvedically, type 2 diabetes is seen as a condition of low *agni* (digestive fire) and increased kapha dosha. Mohan also finds increased kapha common among in this population, though he sees some patients with increased pitta dosha as well. The yogic approach would vary depending on the ayurvedic imbalance in the particular patient. In considering pranayama techniques, for example, Mohan says, "*Sitali* [cooling breath], inhaling through a curled tongue, can be used to reduce pitta, and *anuloma* ujjayi [divided inhalation with pauses] to reduce kapha."

Blossom finds that "*mayurasana* [peacock pose], *uddiyana bandha kriya* , seated and lying twists, and vinyasas [flowing sequences of poses] that involve movements in the frontal plane of motion such as the forward-bending and back-bending employed in variations of the sun salutation are the most important." Since many people with type 2 diabetes cannot do a difficult pose like mayurasana, he offers the following: "A modified mayurasana can be done at first by coming into a child's pose (*balasana*) with one's hands in soft fists placed between the abdomen and one's thighs so that light pressure is felt in the soft tissue below the ribs. This posture can be gradually developed to a more traditional-looking variation, where students place their elbows in their abdomen but keep their knees down on the ground." He stresses the need for "the student to learn to breathe smoothly at each stage of modification."

"Uddiyana bandha," Blossom says, "is done in a standing squat where the knees are bent in a position similar to *utkatasana* [chair pose] and the hands are placed on the knees with the elbows straight. At the end of the exhalation one suspends the breath, relaxes the belly, and then gently draws the navel back toward the spine. This causes the entire abdominal wall to pull toward the viscera. After 2 to 5 seconds, one releases the navel forward then stands up and inhales while raising the hands over the head. The next round of the practice begins by exhaling the breath, lowering the arms back to the knees, and squatting." In students who are able to do it, he will sometimes add uddiyana bandha to seated and supine twists during the suspension of breath after the exhalation.

Aadil Palkhivala often recommends poses such as *ardhajathara parivartanasana* (revolved-abdomen pose) with bent knees and *matsyangasana* (mermaid pose), a strong spinal twist from a seated position (see Fig. 11.4 A,B). He typically advises that his students with type 2 diabetes practice twice per day, doing 9–54 repetitions of ardhajathara parivartanasana and one to three repetitions of matsyangasana on each side.

Shanti Shanti Kaur Khalsa notes a high rate of concurrent depression and/or excessive stress in patients with type 2 diabetes. She finds that they often have dysfunctional belief patterns such as perfectionism and fatalism. “We use rhythmic targeted movement, synchronizing breath and movement, and meditations specifically to build vitality, restore endocrine and neural strength and balance, and overcome depression,” she says. “Pranayama techniques are used throughout.”

Figure 11.4 A, B

Two views of *matsyangasana* : (A) coming into the pose, and (B) the full pose.
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Mohan notes that, “Diabetes in itself does not necessarily impose restrictions on the asana practice. However, complications and associated health problems such as loss of sensation from peripheral neuropathy, and contraindications to strenuous practice or inversions from obesity, high blood pressure, or heart disease should be kept in mind.”

Timothy McCall says mindfulness of the feet is particularly important in those with neuropathy. He suggests avoiding all jumping from pose to pose and balancing poses such as *sirsasana* (headstand), in which falling out of the pose is a risk, and recommends that those with significant foot neuropathy consider wearing shoes during their practice, ideally a clean pair dedicated solely to practicing yoga.

Khalsa says, “Nothing in our curriculum calls for inversions, breath of fire [an intense breathing technique] or standing poses. Most of what we do for people with diabetes can also be done in a chair, if that is what is needed to support the student. For very overweight people, we advise sitting in a chair instead of lying on the back during deep relaxation.”

Although it is usually recommended to practice yoga on an empty stomach, this may not be advisable for those with diabetes whose medication puts them at risk of hypoglycemia. McCall recommends a light snack an hour or so before yoga, and suggests that juice be available in the event of hypoglycemia during the practice. He also cautions that students who take on a regular yoga practice may need to have their levels of medication adjusted to prevent hypoglycemic episodes.

Attention to diet is an integral part of the yogic approach to the care of diabetes. In addition to recommending such measures as reducing calories in overweight people with type 2 diabetes and eating to help correct ayurvedic imbalances, yoga teachers encourage students to avoid mindless eating, for example, eating in front of the television or computer. McCall suggests making meals more like a meditation, eating slowly and mindfully. Mohan says, “I may also teach a classical mantra on the life force or prana, or a similar affirmation in the person’s own language, as a ritual to bring about a relationship with food that views eating as an act of nourishing and supporting the health of the body rather than purely a matter of taste.”

Khalsa says, “In my clinical work I notice that people with type 2 diabetes who practice yoga also improve their health habits. They report making healthier food choices, improve their sleep routine, show greater adherence to medical advice and treatment, and provide themselves with better self-monitoring and self-care.”

Resource

Book: *Yoga and Diabetes* by Annie B. Kay and Lisa B. Nelson

CHAPTER TWELVE

YOGA THERAPY FOR METABOLIC SYNDROME AND WEIGHT CONTROL

K YANG • J RIOUX

Introduction

Research has identified obesity as a causal factor in the development of type 2 diabetes (T2DM), hypertension, cardiovascular disease (CVD), metabolic syndrome, insulin resistance syndrome, and some cancers (Anderson & Taylor, 2011; Innes & Vincent, 2007; Innes, Bourguinon & Taylor, 2005; Mamtani & Mamtani, 2005). These conditions can lead to premature death and play a role in morbidity, often leading to unemployment, lost earnings, reduced quality of life, and mortality (Innes et al., 2005). As chronic conditions that interfere with daily function and overall well-being, obesity and metabolic syndrome are linked with other psychosocial comorbidities. They are also connected to high health care costs and frequent visits to conventional care providers (Bertisch, Wee, & McCarthy, 2008). Conventional care paradigms for obesity and metabolic syndrome treatment are expensive and may involve surgery and medications with side effects (Franz et al., 2007). In contrast, yoga is inexpensive, noninvasive, and can be used as primary or supplemental self-care for weight loss, weight maintenance, or prevention of obesity and metabolic syndrome.

Pathophysiology, etiology, and prevalence of obesity and metabolic syndrome

According to the World Health Organization (WHO, 2015), rates of obesity worldwide have doubled since 1980. In 2008, 1.4 billion adults (35%) over the age of 20 were overweight (body mass index [BMI]: 25–30), and 200 million men and 300 million women (11% total) qualified as obese (BMI > 30). Forty million children under age 5 were obese (i.e., BMI at or above the 95th percentile for children of the same age and sex) in 2012. Obesity has historically been linked to countries with higher per capita income. However, obesity is currently on the rise in urban areas in countries with middle and low per capita incomes. In countries with emerging economies, the rate of childhood obesity is sometimes 30% higher than in high-income countries. Worldwide, 65% of people live in countries where being overweight is responsible for more deaths than being underweight. Approximately 3.4 million deaths each year are linked to overweight and obesity; 44% of T2DM cases, 32% of ischemic heart disease, and between 7% and 41% of cancers have a causal link with overweight and obesity. Most importantly, obesity and metabolic syndrome are preventable (WHO, 2015).

Metabolic syndrome is a combination of endogenous risk factors for T2DM and CVD: increased waist circumference, increased triglycerides, decreased high-density lipoprotein cholesterol (HDL), increased blood pressure (BP), and increased fasting glucose (Grundy et al., 2005; Parikh & Mohan, 2012). Various organizations have supported different definitions of metabolic syndrome (Grundy et al., 2005; Parikh & Mohan, 2012). Recently, however, these organizations agreed on unified criteria for metabolic syndrome with the following risk factors: raised BP (systolic ≥ 130 and/or diastolic ≥ 85 mmHg), raised triglycerides (≥

150 mg/dL), lowered HDL (< 40 mg/dL in men, < 50 mg/dL in women), raised fasting glucose (≥ 100 mg/dL), and increased waist circumference (Alberti et al., 2009). In order to reflect different criteria for central obesity, this new definition will apply population- and country-specific thresholds for waist circumference (Alberti et al., 2009). For example, the threshold for waist circumference is 102 cm and 88 cm in the United States but 85 cm and 90 cm in Japan (for men and women respectively). Of these five risk factors, three abnormal findings indicate metabolic syndrome (Alberti et al., 2009). Based on the unified metabolic syndrome criteria, 22.9% of US adults in 2010 had metabolic syndrome, a slight decline from 25.5% in 1999 (Beltran-Sanchez, Harhay, Harhay, & McElligott, 2013).

The presence of abnormal individual components related to metabolic syndrome increases the risk for T2DM. Prediabetes has shown significant associations with obesity, dyslipidemia, and hypertension and increased risk for the future development of T2DM (American Diabetes Association, 2014). Prediabetes is defined as impaired fasting glucose (fasting plasma glucose: 100–125 mg/dL), impaired glucose tolerance (2-hour fasting glucose oral glucose tolerance test: 140–199 mg/dL), or 5.7–6.4% of A1C level (American Diabetes Association, 2014). According to a National Diabetes Statistics Report, 37% of US adults had prediabetes in 2009–12 (Centers for Disease Control and Prevention, 2014).

Scientific/psychophysiological rationale for the use of yoga for metabolic syndrome and weight control

Benefits of yoga as a physical activity

There is ample evidence that physical activity lowers the risk of obesity and metabolic syndrome (Physical Activity Guidelines Advisory Committee, 2008). One recent study showed that among obese men, exercise-induced weight loss resulted in greater improvements in insulin sensitivity than did diet-induced weight loss (Ross et al., 2000). Exercise has been shown to have a positive effect on insulin sensitivity by improving glucose uptake by 30% even in the absence of weight loss or a reduction in body fat (Ross et al., 2000). Physical fitness is also inversely associated with inflammation (Kiecolt-Glaser et al., 2010), and regular exercise is associated with lower levels of proinflammatory cytokines. It has been suggested that abdominal adiposity is associated with overstimulation of the hypothalamic–pituitary–adrenal (HPA) axis as a result of altered daytime cortisol secretion and chronic stress (Dhananjai, Sadshiv, Tiwari, Dutt, & Kumar, 2013).

Yoga is an increasingly popular form of physical activity, the practice of which includes relaxation, breathing exercises, and physical postures (Nayak & Shankar, 2004). Postures, breath work, meditation, and relaxation are the primary components of most therapeutic yoga interventions. Each of these components fulfills a purpose in the overall treatment paradigm of yoga for obesity and metabolic syndrome. Yoga postures are a form of physical activity and serve as tools for stress reduction and pacification of the nervous system either solo or in various combinations with breathing exercises, meditation, and relaxation.

According to a current compendium of physical activity research (Ainsworth et al., 2000), the metabolic equivalent (MET) of hatha yoga is 2.5 (1 MET equals the amount of energy used for quiet sitting). Clay et al. (2005) recently found a 30-minute hatha yoga routine to have an MET of 2.17 in young adult women. However, if the session was made more active using sun salutations, a flowing series of physical postures, the MET increased to 3.74 (SD = 0.70), making it a moderate-intensity exercise.

Connections between behavior change, immune status, and nervous system regulation are relevant for the treatment effects of yoga on obesity and metabolic syndrome. The current evidence demonstrates that psychological and physical activity variables included in intensive lifestyle/behavior change interventions, like yoga therapy, may improve health status and minimize risk for developing disease by reducing systemic inflammation and dysfunctional adipocytes (Dhananjai et al., 2013; Kiecolt-Glaser et al., 2010).

Chronic stress and inflammation

Research has demonstrated the causal link between chronic stress and inflammation, as well as demonstrating that obesity creates a constant state of low-grade inflammation; hence these become mutually reinforcing causal links. Inflammation is associated with elevated plasma levels of interleukin-6 (IL-6), C-reactive protein (CRP), and tumor necrosis factor alpha (TNF-α); thus, a reduction in weight may also reduce inflammation in the body systemically. Adipose tissues synthesize and release adipocytokines, behaving as an endocrine organ. Nutrition overload mediates inflammation and leads to cellular stress. Chronic stress has also been linked to overproduction of diurnal cortisol and IL-6.

Research has identified four important biomarkers relevant to obesity, metabolic syndrome, and endocrine disorders that have been included in more recent studies of yoga intervention clinical trials: CRP (which increases inflammation); IL-6 (which increases inflammation); leptin (which increases inflammation and demonstrates increased expression in obesity); and adiponectin (which reduces insulin resistance, oxidative stress, and inflammation and is decreased in obesity). Leptin is also positively correlated with CRP and IL-6 (Sarvottam & Yadav, 2014). These biomarkers assist us in elucidating some of the biomedical pathways influenced by obesity and contribute to understanding how its treatment effectiveness can be measured.

Studies demonstrate that yoga addresses stress and the risk of inflammation. It reduces anxiety and depression by reducing sympathetic nervous system tone, consequently reducing inflammation (Kiecolt-Glaser et al., 2012). The effects of yogic mindfulness minimizes the autonomic response to stress, promotes resilience, and decreases diurnal cortisol through the HPA axis. The findings of one study indicate that more weeks of yoga practice in a year, more lifetime yoga sessions, and more years of yoga practice overall were significantly associated with lower leptin, which in turn affects the adiponectin-to-leptin ratio (Kiecolt-Glaser et al., 2012). Leptin is proinflammatory, while adiponectin reduces inflammation. These adipocytokines are also associated with depression and anxiety, two psychological comorbidities that may accompany obesity and often improve with increased physical activity. If yoga decreases anxiety and depression, as studies have shown (Kiecolt-Glaser et al., 2012), then yoga may positively affect adipocytokine expression over the long term. Likewise, yoga’s positive effect on anxiety and depression may counteract negative behavioral dispositions that contribute to overeating and sedentary lifestyles.

Hyperactivation of the HPA axis, caused by stress, is also related to metabolic disorders. Stress raises fasting plasma cortisol concentrations and is significantly associated with insulin resistance (Phillips et al., 1998). In one study, yoga showed beneficial effects in stress management, and yoga practice helped physiological stress reduction among adults aged 21–30 (Bera, Gore & Oak, 1998). After inducing physiological stress with scheduled treadmill running, yoga corpse posture was more effective in recovery of systolic BP than the resting posture in a chair or a supine posture. After 10 sessions of yoga for 5 weeks (Woolery, Myers, Sternlieb, & Zeltzer, 2004), young adults showed higher morning cortisol levels, which have been associated with lower levels of nervousness, compared to the control group (0.43 μg/dL vs. 0.32 μg/dL, $p = .08$).

Research has demonstrated that there is a dose–response relationship between stress and obesity and that stress provokes consumption of foods high in sugar and fat content. Chronic stress, depression, and negative affect are also associated with insulin resistance, abdominal adiposity, glucose intolerance, dyslipidemia, hypertension, and metabolic syndrome (Anderson & Taylor, 2011). Studies have shown that yoga can mediate these processes. Yoga has been shown to decrease fatigue, pain, anxiety, and depression and improve sleep (Ross & Thomas, 2010). A review of yoga interventions found that physiological risk factors associated with metabolic syndrome improved with yoga practice (Innes et al., 2005). Decreasing activity and reactivity of the sympathoadrenal system and the HPA axis, as well as activation of the vagus nerve, may shift autonomic nervous system balance, increasing parasympathetic tone. The effects of this may be improved mood, reduction in chronic stress, and the promotion of subsequent positive neuroendocrine states, metabolic function, and decreased inflammation (Taylor, Goehler, Galper, Innes, & Bourguinon, 2010).

Review of published research on yoga

Yoga research for weight loss

All studies related to obesity met the search criteria “yoga and obesity” or “yoga and weight loss” in a search of the PubMed, Medline, and PsycINFO databases from 1995–2015. Forty-four appropriate studies were identified for review; excluded were systematic reviews, articles with a mechanistic focus, articles without an objective quantitative weight-related measure, epidemiological studies, brief reports, editorials, and multi-component programs. The 23 included studies demonstrate diversity in type, size, health status of the population, intervention design, and comprehensiveness and frequency of yogic practice. These features are primary in considering the effectiveness of yoga as a therapeutic strategy for weight loss and weight maintenance (Rioux & Ritenbaugh, 2013). The studies reviewed include only randomized or nonrandomized controlled trials and uncontrolled pre–post designs with objectively obtained quantitative weight measures. Table 12.1 (see p. 250) reports the sample size for each study; health status of the sample; mean age or age range of the population; the type of yogic elements included in the intervention; the type of control used, if any; the frequency and duration of both the program and individual sessions; and the country in which the research was conducted.

All the included studies collected anthropometric outcome measures, typically a pre–post measure of either weight and/or BMI, as an indicator of the effect of the intervention. The sample sizes ranged from 6 to 205. Of the 23 studies, 11 were conducted in India, 7 in the United States, 2 in South Korea, 1 in Thailand, 1 in Sweden and 1 in China. Control conditions, when present, included walking; waitlist; conventional physical activity; health education; usual care; diet; drug therapy; circuit training; treadmill; or comparison to young, lean subjects. The duration of interventions ranged from 6 days to 1 year in sessions of 45 minutes to 4 hours, with the frequency of the session varying from 2 to 7 days per week. Interventions were composed primarily of varied styles of hatha yoga, including Viniyoga, vinyasa, Bikram Yoga, and ashtanga.

Most studies provided only simple baseline and postintervention group means for weight-related measures, for both the intervention and control groups. Some studies also included the parameters of body fat percentage per lean mass and/or waist and hip circumference and ratio. Table 12.1 (see p. 250) reports the effectiveness of each intervention based on weight, BMI, body fat percentage, or changes in waist circumference, as evidence for the effectiveness of each intervention for weight loss or obesity treatment. The most common additional nonanthropometric outcomes were BP, glucose/insulin levels, lipid parameters, exercise capacity, flexibility, strength, balance, VO_2 max, resting heart rate, quality of life, program satisfaction, self-esteem, anxiety, and, in more recent studies, leptin/adiponectin.

Of the 23 studies reviewed, 22 (96%) established some quantitative reduction in weight, BMI, or body fat percentage. Clinically significant weight loss is typically regarded as 5%+ of body weight. An epidemiological study in Ireland found that a 1-point reduction in BMI resulted in 26% less chronic disease in women and 28% less chronic disease in men (Kearns, Dee, Fitzgerald, Doherty & Perry, 2014). Utilizing these criteria, 12 of 23 studies (52%) achieved approximate clinically relevant weight loss or chronic disease risk reduction, regardless of duration of the intervention, frequency of practice, or length of each session.

The question of “dosage” in yoga therapy for disease treatment or risk reduction is a subject of much discussion. In the area of weight loss and obesity, the more important factor becomes the sustainability of the effect, in terms of weight loss, and the durability of lifestyle change over time. Most studies of yoga for treatment of overweight and obese individuals have presented only pre- and post-measures and have not followed the subjects to determine if weight loss was maintained over time. One recent exception collected objective, quantitative weight loss data at 3 and 6 months postintervention (Rioux, Thomson & Howerter, 2014). Study data showed 3.8% weight loss at the completion of the intervention, continued weight loss of 4.9% at 3 months postintervention, and even greater weight loss of 6% at 6 months postintervention. No treatment, yoga classes or support groups were provided during the follow-up period.

Questions remain regarding how long an intervention needs to be to establish durable lifestyle change; the optimal frequency of yoga practice as treatment for overweight and obesity; the optimal length of each session for achieving weight loss; and which yoga components are most critical to include in order to achieve clinically relevant weight loss that is sustainable over time. Among the 12 studies that demonstrated clinically relevant weight loss of approximately 5% or more or ≥ 1 point reduction in BMI, indicating chronic disease risk reduction, 10 (83%) were long term (≥ 8 weeks) (Dhananjai et al., 2013; Manchanda et al., 2000; Mahajan, Reddy & Sachdeva, 1999; Murugesan, Govindarajulu & Bera, 2000; Rioux et al., 2014; Schmidt, Wijga, Von Zur Muhlen, Brabant, & Wagner, 1997; Seo et al., 2012), and 2 (17%) were short term (≤ 8 weeks) (Telles, Sharma, Yadav, Singh, & Balkrishna, 2014; Sivasankaran et al., 2006). Seven of 12 studies (78%) demonstrating clinically relevant weight loss prescribed practice of ≥ 4 times per week minimum (Dhananjai et al., 2013; Guo, Wang, Hu, Wang, & Zhang, 2014; Mahajan et al., 1999; Manchanda et al., 2000; Murugesan et al., 2000; Schmidt et al., 1997; Telles et al., 2014), while the remaining 5 studies prescribed practice of a minimum of 3 times per week (Benavides & Caballero, 2009; Lee, Kim & Kim, 2012; Rioux et al., 2014; Seo et al., 2012; Sivasankaran et al., 2006). Interventions that achieved approximate clinically relevant weight loss varied in length of each session: five interventions were 90 minutes or more per session (Guo et al., 2014; Manchanda et al., 2000; Schmidt et al., 2007; Sivasankaran et al., 2006; Telles et al., 2014); two interventions were 75 minutes per session (Benavidez & Caballero, 2009; Rioux et al., 2014); and five interventions were 60 minutes per session (Dhananjai et al., 2013; Lee et al., 2012; Mahajan et al., 1999; Murugesan et al., 2000; Seo et al., 2012).

Studies also varied in terms of number of yogic elements included and whether dietary and residential components were part of the intervention. Of 14 possible yogic elements identified, 3 of 12 studies (25%) demonstrating approximate clinically relevant weight loss included six or more yogic elements (Manchanda et al., 2000; Rioux et al., 2014; Schmidt et al., 2007). Seven of 12 studies (58%) included three to five yogic elements (Benavides & Caballero, 2009; Dhananjai et al., 2013; Guo et al., 2014; Mahajan et al., 1999; Murugesan et al., 2000; Sivasankaran et al., 2006; Telles et al., 2014); and 2 studies (17%) included only two yogic elements (Lee et al., 2012; Seo et al., 2012). Five of 12 (42%) studies approximating clinically significant weight loss included a residential component (Mahajan et al., 1999; Manchanda et al., 2000; Schmidt et al., 1997; Seo et al., 2012; Telles, Naveen, Balkrishna, & Kumar, 2010), and 6 of 12 (50%) included a dietary component (Mahajan et al., 1999; Manchanda et al., 2000; Rioux et al., 2014; Schmidt et al., 1997; Seo et al., 2012; Telles et al., 2014) in the intervention.

Statistical analysis varied across studies, with 10 studies calculating *p* values between intervention and control groups (Dhananji et al., 2013; Hunter et al., 2013; Littman et al., 2012; Mahajan et al., 1999; Manchanda et al., 2000; McCaffrey, Ruknui, Hatthakit, & Kasetsomboon, 2005; Murugesan et al., 2000; Schmidt et al., 1997; Seo et al., 2012; Yang et al., 2011), while 3 studies with control groups only calculated within-group *p* values (Jakhotia et al., 2015; Lee et al., 2012; Telles et al., 2014) and 10 studies did not include control groups (Benavides & Caballero, 2009; Guo et al., 2014; Jain & Talukdar, 1995; Raju, Prasad, Venkata, Murthy, & Reddy, 1997; Rioux et al., 2014; Sarvottam, Magan, Yadav, Mehta, & Mahapatra, 2013; Sivasankaram et al., 2006; Telles et al., 2010; Thomley, Ray, Cha, & Bauer, 2011; Tran, Holly, Lashbrook, & Asterdam, 2001). Six studies calculating *p* values between groups showed statistical significance in at least one anthropometric variable (Dhananji et al., 2013; Hunter et al., 2013; Manchanda et al., 2000; McCaffrey et al., 2005; Murugesan et al., 2000; Seo et al., 2012). Of these six studies, the intervention duration was between 8 and 11 weeks for four studies (Hunter et al., 2013; McCaffrey et al., 2005; Murugesan et al., 2000; Seo et al., 2012). The other two studies had an intervention of 6 months (Dhananji et al., 2013) and 1 year (Manchanda et al., 2000). In three of six studies participants practiced 3 times a week (Dhananji et al., 2013; McCaffrey et al., 2005; Seo et al., 2012) and in the remaining three studies, participants practiced 6–7 times a week. The number of minutes practiced per day was 60 minutes for three studies (Dhanaji et al., 2013; McCaffrey et al., 2005; Seo et al., 2012) and 90–120 for the remaining three studies (Hunter et al., 2013; Manchanda et al., 2000; Murugesan et al., 2000), and two of the six studies had a residential component (Manchanda et al., 2000; Seo et al., 2012).

Yoga research for metabolic syndrome

To review the literature on yoga interventions for metabolic syndrome, we searched literature databases Medline via EBSCO, CINAHL, and PubMed using a keyword of “yoga” and limited results by samples with metabolic syndrome, prediabetes, glucose intolerance, or high risk for T2DM within the past 10 years. A total of eight studies were identified, but one study (Khatri, Mathur, Gahlot, Jain, & Agrawal, 2007) was excluded due to lack of intervention information. Table 12.2 (p. 264) summarizes characteristics of reviewed studies. Out of seven, two studies (Hegde, Adhikari, Shetty, Manjrekar, & D’Souza, 2013; Kim, Ryu, Kim, & Song, 2013) were conducted outside the United States (in India and South Korea). Sample size ranged from 23 to 180. There are only a few studies using yoga in metabolic syndrome and limited consensus on metabolic syndrome definitions among the reviewed studies. Out of seven, four studies included people with metabolic syndrome defined by either National Cholesterol Education Program (NCEP) or International Diabetes Federation (IDF) criteria.

One study (Hunter et al., 2013) used a pre-experimental study design, and six studies used a randomized controlled clinical trial design including two studies (Cohen, Chang, Grady, & Kanaya, 2008; Kanaya et al., 2014) with stratified randomization by gender and race. The control conditions included waitlist, stretching exercise, conventional physical activity, and health education. The most commonly used intervention was a restorative yoga program (Cohen et al., 2008; Corey et al., 2014; Kanaya et al., 2014). In addition to traditional yoga styles such as hatha and vinyasa, Bikram Yoga (i.e., hatha yoga with at 40.5 C ° and 40–60% humidity and a set sequence of 26 poses) was used (Hunter et al., 2013). The duration of interventions ranged from 8 to 24 weeks in sessions of 60–90 minutes, and the frequency of the intervention varied from 1 to 5 days per week.

Systolic BP was significantly improved with yoga intervention among people with metabolic syndrome or prediabetes. After a yoga program with 75–90 minutes a day for 5 days a week over 3 months, adults with prediabetes experienced improved systolic BP, from 125.5 to 119.1 mmHg (Hegde et al., 2013). Sedentary overweight adults with metabolic syndrome showed 9.2 mmHg differences in change between the yoga intervention group (15 sessions of a 90-minute yoga program over 10 weeks using restorative yoga) and the waitlist control group (Cohen et al., 2008). A study using a 3-month yoga intervention (N = 23) found that the yoga group (24 sessions of 60 minutes over 3 months) experienced improvements in systolic BP (decreasing from 119.3 mmHg to 114.1 mmHg) indicated by large effect sizes (d = 0.62), compared to the education group (Yang et al., 2011).

In a study with a 12-week hatha yoga intervention (60 minutes twice weekly), the difference in systolic BP in the intervention group was significantly larger than in a waitlist control group (Kim et al., 2013). However, within-group difference was not significant in the yoga group. Interestingly, in the same study, fasting glucose, triglycerides, and HDL were significantly improved between pre- and postintervention, while there were no significant between-group differences (i.e., yoga vs. waitlist control). This pattern was seen in a study using stretching as a control group (Kanaya et al., 2014). Although there was no significant between-group difference, the yoga group experienced significant improvement in HbA1c, HDL, waist circumference, and fasting insulin after receiving a restorative yoga intervention.

Some studies with a sample of people with metabolic syndrome or prediabetes have shown that the yoga intervention significantly improved fasting glucose. After a 6-month restorative yoga program (90-minute sessions twice per week for 12 weeks followed by weekly sessions for 12 weeks) with lifestyle counseling including nutrition, underactive people with metabolic syndrome showed significant improvement in fasting glucose compared to the stretching group (difference between groups: −0.33 mmol/L) at 12 months (Kanaya et al., 2014). In addition, after baseline data were controlled, patients with prediabetes in a 3-month traditional yoga program showed significant improvement in fasting plasma glucose, compared to the control group (Hegde et al., 2013). However, after an 8-week Bikram Yoga program, older obese adults (mean age, 46 ± 12 years, mean BMI, 34.3 ± 4.7 kg/m^2) showed improved glucose intolerance measured by a 75 g oral glucose tolerance test, but their fasting plasma glucose values did not significantly change (Hunter et al., 2013).

Methodological considerations

Yoga therapy is a whole-system healing modality, meaning it is a multifactorial and complex intervention including a number of components that mutually enhance one another to achieve synergistic therapeutic effects. In yoga therapy, emphasis is on the entire simultaneous spectrum of actions in multiple, interdependent subsystems of individual physiology as a whole. Yoga therapy as a healing modality focuses on the cumulative effects of multiple agents—postures, breathing techniques, relaxation/meditation—acting simultaneously on the individual as a biopsychosocial network. Therapeutic yoga recognizes that physiological and psychoemotional factors contribute to bidirectional causality (Rioux, 2012), just as there are multiple causes and multiple manifestations of obesity and metabolic syndrome. A dynamic systems perspective is consistent with systems-based models of obesity causality that inform optimal frameworks for treating obesity and metabolic syndrome. Multiple causal factors mutually enhance and reinforce one another in a synergistic fashion in the individual with metabolic syndrome (Anderson & Taylor, 2011).

The match between a systems approach to addressing the multiple causal factors of obesity and metabolic syndrome and the systems approach to treatment inherent within yoga may provide optimal therapeutic effects; however, it also creates design and analysis issues in research where isolation of an individual cause is the gold standard of the randomized controlled clinical trial (RCT). Yoga provides exercise, stress reduction, nervous system balance, shifting of metabolic function, and anti-inflammatory effects to address many of the root causes associated with obesity and metabolic syndrome, but demonstrating the synergy between causes and effects calls for dynamic, whole-systems research strategies.

Appropriateness of causal models used in conventional research

Yoga therapy research typically utilizes biomedical outcome measures, but indigenous medical theories from India that are historically associated with therapeutic yoga call for consideration of distinct causal models and associated outcome measures.

Ayurveda is a system of East Asian medicine that provides an alternate causal framework for the treatment effects of yoga therapy. It provides another perspective from which to understand the therapeutic pathways of a yogic intervention to treat obesity or metabolic syndrome. Ayurvedic theory focuses on the balanced or imbalanced expression of the five elements of air, space, fire, water, and earth in the human body, mind, and spirit. An Ayurvedic causal framework mirrors some of the variables associated with obesity from the perspective of biomedicine and combines these with a humoral approach to disease development. Ayurveda defines obesity as a metabolic disorder in which there is excessive accumulation of fat as adipose tissue caused by accumulation of the water and earth elements and characterized by poor digestive fire and low metabolism. Overeating and a sedentary lifestyle contribute to the accumulation of earth and water elements in the body, as does excess sleep, steroid medications, and psychoemotional conditions such as depression and anxiety. Earth and water are associated with the heavy, dense, slow, and cold qualities and are antagonistic to strong metabolic fire—which is sharp, light, and hot—thus contributing to slow metabolism and obesity.

Ayurveda treats obesity through dietary change, exercise methods such as yoga, improving negative psychoemotional states, and cleansing accumulated toxins from bodily tissues, thereby improving metabolism overall. Asana, pranayama, and meditation address obesity by counteracting the slow, static, cold, heavy, and dense qualities; not simply by utilizing specific poses and sequencing, but also particular combinations of duration and frequency of yoga practice, aimed at contradicting the qualities associated with accumulation of the earth and water elements and associated weight gain. One research study of yoga for obesity has included outcome measures associated with Ayurvedic medicine (Rioux & Ritenbaugh, 2013; Rioux et al., 2014).

Summary and conclusions, clinical relevance, and future research directions

This chapter reviewed primary data from clinical trials of yoga interventions for obesity and metabolic syndrome and investigated current theory on causality and mechanistic pathways that have been postulated for yoga therapy interventions as effective strategies for prevention, risk reduction, and treatment of obesity and metabolic syndrome.

Obesity

The use of yoga as a treatment for obesity may have significant public health implications, given that the WHO has identified obesity as an epidemic in both adults and children in the global population. As an economical, noninvasive practice with potentially synergistic effects, yoga may provide an intervention with few adverse events, no identified negative side effects, multiple coordinated benefits of lifestyle change, and high rates of documented adherence and home practice. Therefore, yoga may be a core primary or adjunctive clinical therapy for obesity and risk-reduction or prevention of associated diseases.

Research on the efficacy of yoga as a treatment for obesity is growing, though studies vary in overall quality and methodological rigor. Sample sizes are often small, and studies may not be randomized, blinded, or controlled. The orientation, intensity, comprehensiveness, and duration of yoga therapy interventions for obesity also vary widely across reported studies, making direct comparisons difficult. However, researchers have published sufficient studies to permit a review of the literature in an effort to summarize the state of research regarding the effectiveness of yoga as a treatment method or a risk-reduction or prevention strategy for obesity.

According to the studies reviewed, yoga appears to be an appropriate and potentially successful intervention for weight maintenance, prevention of obesity, and risk reduction for diseases in which obesity plays a significant causal role. Therapeutic yoga programs are frequently effective in promoting weight loss and/or improvements in body composition. The effectiveness of yoga for weight loss is related to the following key features: (1) increased frequency of practice, (2) longer intervention duration, (3) inclusion of a yogic dietary component, (4) inclusion of a residential component, (5) the comprehensiveness of yogic elements included, and (6) a home-practice component.

Metabolic syndrome

Even though research shows that yoga has the potential to reduce individual metabolic risk factors, it is still important to understand the effects of a yoga program on metabolic syndrome because metabolic syndrome, a cluster of metabolic factors, increases the risk for T2DM and cardiovascular diseases (Grundy et al., 2005; Parikh & Mohan, 2012). According to our review, yoga has been shown to improve cardiometabolic factors among those with metabolic syndrome and prediabetes. These findings will be broadly applicable to a large proportion of the global population with these conditions and may significantly contribute to healthier lifestyles and longer, more productive lives. However, more intervention studies in this particular population will be needed to test the consistency of beneficial results over the longer term and in different settings.

Reviewed studies have provided details of the yoga programs, but there is still limited information regarding dose–response relationships. None of the studies reviewed used objective measures or devices to assess dosage or the amount of intervention delivered. Compared to general forms of physical activity (e.g., brisk walking or jogging), measuring the intensity of yoga would require more complicated considerations because interventions should reflect at least three primary therapeutic aspects of yoga (various postures, breathing techniques, and relaxation). It will be a challenge to make yoga programs more standardized while preserving the holistic, flexible, and comprehensive approach of yoga. However, these efforts will help us promote fidelity of the paradigm and advance scientific knowledge of yoga practice in this particular population.

Among various types of yoga, hatha yoga is the most familiar type to Westerners (Gilbert, 1999), but it is still unknown which types of yoga might work best for metabolic syndrome. In addition, it is imperative to conduct comparative studies to compare various types of yoga with different dosages and propose the best set of programs for metabolic syndrome. Equally, it will be important to collect information on long-term adherence and health-related outcomes (i.e., diabetes incidence rate) of yoga programs among people with metabolic syndrome.

Table 12.1 Summary table of obesity research

Author/year/country	Sample	Study design	Intervention	Control
Benavides et al., 2009 USA	20 children, 71% overweight/obese Ages 8–15, At risk for type 2 diabetes	Uncontrolled pre–post	•Modified ashtanga yoga: asana, pranayama, meditation •3 months, 3 days per week, 75 min classes	None
Dhananjai et al., 2013 India	205 obese adults w/anxiety or depression Mean age 34.2 Waist circumf ≥ 90 cm men; ≥ 80 cm women	Nonrandomized controlled trial	•Standardized SVYASA Yoga: asana, pranayama, relaxation, meditation •No dietary restriction •6 months, 5 days per week, 60 min per session	67 subjects Aerobic exercise Mean age: 32.9
Guo et al., 2014 China	50 overweight women Mean age: 36.8 Yoga club setting	Uncontrolled pre–post study	•Bikram Yoga 5 min warm-up, 80-min asana, 26 fixed postures, 5 min cool; pranayama, relaxation •40 °C room temp. •1 year, 4 × weekly, 90 min each	None
Hunter et al., 2012 USA	29 obese adults at risk for metabolic syndrome Mean age: 46 Sedentary for 6 mos.	Controlled pre–post study	•26 prescribed postures, standardized instructions, relaxation •Sauna-like environment, 40.5 °C, 40–60% humidity •Normal diet, no other physical activity •8 wks, 3 × per wk, 90 min each	Young, lean subjects Same intervention Mean age: 32 (*n* = 14) Sedentary past 6 mos
Jain et al., 1995 India	30 adults with T2DM	Uncontrolled pre–post study	•Residential: visceral cleansing procedures (*shat kriya*), asana, pranayama, meditation; isocaloric vegetarian diet •40 days, 2 × per day, 1 hour each	None
Jhakota et al., 2015 India	119 overweight/obese women Mean age: 29.6 BMI > 25 < 35 No exercise prior 3 mos	Randomized, controlled trial	•10-min warm-up, modified suryanamaskar (with chair), 12 standardized asana, pranayama, 10 min cool down	1) Circuit training (CT) 2) Treadmill walking (TM) 3) No exercise/dietary change (C)

	Community setting		• 45–60 min per session, daily	
Lee et al., 2012 South Korea	16 obese postmenopausal women at risk for metabolic syndrome Mean age 54.5 Sedentary	Randomized controlled trial	• Aligned postures, breathing techniques, relaxation • Developing flexibility, strength, lung capacity, and balance • Normal diet • 16 weeks, 3 × per week, 60 min class	No exercise (n = 8) Normal diet
Littman et al., 2011 USA	63 overweight/obese breast cancer survivors No prior yoga 21 to 75 years	Randomized controlled trial	• Facility/home-based viniyoga asana, pranayama, meditation • Standardized class manual; DVD for home practice • No dietary advice • Email/telephone counseling and motivational interviews • 6 mos, 3–5 × a week, 75 min each	Waitlist control (31); randomized by age, cancer stage, BMI
Mahajan et al., 1999 India	93 adults Two groups: (1) angina; (2) normal with ≥ 2 risk factors for coronary artery disease Age: 56–59 years	Randomized controlled trial	• Residential: asana, pranayama, meditation, relaxation • Yogic diet, no calorie restriction or drug therapy • 4-day residential, 1 hr daily • 14 weeks home practice, 30 min asana/30 min meditation	Both groups: Control (N = 41); conventional care, control of risk factors, lifestyle advice 1) coronary risk factors (CRF) 2) angina (A)
Manchanda et al., 2000 India	42 adults Angiographically proven coronary artery disease and chronic stable angina Mean age: 51 yrs	Randomized controlled trial	• 4-day residential program • 1-year home practice. 90 mins per day • Yogic lifestyle, aerobic exercise, stress management, control of risk factors • Psana, relaxation, meditation,	Conventional risk factor control/ Heart Association's Step-1 diet (N = 21)

			pranayama, social support, yogic philosophy •Low-fat, low cholesterol, high carbohydrate, high fiber diet	
McCaffrey et al., 2005 Thailand	61 adults with hypertension diagnosis Mean age: 56 No current medication	Randomized controlled trial	•Pranayama, asana, yogic philosophy, stress reduction •Social support; health education •Yoga training cassettes; classes led by trained teacher •8 weeks, 3 × a week, 63-min classes	Outpatient care, hypertension education, no yoga or stress reduction
Murugesan et al., 2000 India	33 adults with hypertension diagnosis Age: 35–65	Randomized controlled trial	•3-arm study: 1) yoga (I); 2 drug treatment (DT); 3) therapeutic advice (NT) •Asana, pranayama, relaxation, meditation, mantra •11 weeks, 6 days per wk, 2 × per day, a.m. & p.m., 60 min each	2) drug treatment-11 3) therapeutic advice, no treatment -11
Raju et al., 1997 India	6 healthy adult females Mean age = 25.6	Uncontrolled pre–post study	•Residential program, 8 techniques: 4 pranayama, 4 asana •4 weeks, 2 × per day, 90 min each	None
Rioux et al., 2014 USA	12 obese/overweight adults Mean age: 41.3 Yoga novices	Uncontrolled pre–post study	•Asana (60 min), pranayama (5 min), relaxation (10 min) •Gradual increase in pose holds and transition speed; sun salutations at 5 weeks •Individual Ayurvedic diet and lifestyle changes; social support; sensory withdrawal •Follow-up data demonstrates sustainability •12 weeks, 3–6 × per week, 75 min per session	None
Sarvottam et al., 2013	30 obese/	Uncontrolled,	•Pretested	None

India	overweight men at risk for cardiovascular disease Mean age: 39	pre–post study	intervention: individualized advice •Asana, pranayama, social support •6–8 participants per session •Medical management, stress/ substance counseling •Nutrition awareness: vegetarian diet recommended •10 days, 2 × per day, 1 hr each	
Schmidt et al., 1997 Sweden	106 healthy adults Mean age: 29.6 (18–64) Self-selected	Randomized controlled trial	•Residential: asana, pranayama, meditation, kriya; sensory withdrawal; social support •Low-fat, lacto-vegetarian diet; no alcohol/coffee/sweets •**Month 1:** Asana, pranayama, relaxation, meditation •**Month 2:** Begin 33 days of silence, kriya yoga, meditation, asana •**Month 3:** Kriya yoga, asana, meditation •3 months, 4 + hrs per day	Control = people living normal lives in Hanover matched for age, gender and initial risk factors
Seo et al., 2012 South Korea	20 obese adolescent boys Mean age: 14.7	Controlled pre–post study	•Exercise at 40–60% heart rate reserve (HRR) •Education: T2DM risk factors, diet, physical activity •Staged asana protocol w/modulated intensity; relaxation •8 weeks, 3 × per week, 60-min class; residential	Mean age: 14.6 yrs Exercise < 30 min weekly (n = 10) No changes in diet
Sivasankaran et al., 2006 India	33 adults 30% with and 70% w/out coronary artery disease Mean age: 55 No yoga practice	Uncontrolled pre-post	Seminar on yoga and heart disease prior to enrollment •15 min meditation; 15 min pranayama; 40 min asana; •20 min *shavasana* •6 weeks, 3 × weekly 90-min classes	None
Telles et al., 2014 India	68 obese/overweight adults	Randomized controlled trial	45-min sessions: 33-min pranayama, 7-min	90 min per day (n = 34)

	Mean age: 36.4		asana, 5-min relaxation •Residential w/yogic diet •15 days, 90 min per day (two 45-min sessions)	supervised walking
Telles, et al., 2010 India	47 obese adults Age: 17-68 yrs No prior yoga	Uncontrolled pre–post	•Residential yoga program •Emphasis on asana, pranayama, and cleansing practices •Low-fat, high fiber vegetarian diet**,** no restricted portions •6 days, 5 hr per day (two 2.5 hr sessions per day)	None
Thomley et al., 2011 USA	50 self-selected healthy employees Age: 24–76 No previous yoga	Uncontrolled pre–post study	Power vinyasa flow: asana, pranayama, meditation •Journal writing, mindful eating, personal reflection, community support, emails, nutrition goals •Duration increased weekly •6 weeks, 6 days a week, 60- to 80-min sessions	None
Tran et al., 2001 USA	10 healthy volunteers Age: 18–27 yrs No regular physical activity or yoga, prior 6 mos	Uncontrolled pre–post study	•Each session: 10 minutes *pranayama* , 15 minutes warm-up exercises, 50-min asana, 10-min *shavasana* •8 weeks, 2–4 × per week, 85 min per class	None
Yang et al., 2011 USA	23 high risk for T2DM Mean age: 51.7 Non-exercisers	Randomized controlled trial	•Fitness-based vinyasa yoga program: asana and pranayama, relaxation •60-min class, warm-up and relaxation •Certified yoga instructor/PhD nurse; audio CD for home •3 months, 2 × per week, 60 min session	Health-education materials every 2 weeks

BMI: body-mass index; SVYASA: Swami Vivekananda Yoga Anusandhana Samsthana; *P* values: **p* < .05; ***p* < .01; ****p* < .001; ^*p* < .10 – trend; NS: not significant/not stated; (B/T Grps): between groups; (W/I Grp): within-group difference; v: statistical error in original article has been corrected for this publication.

Table 12.2 Summary table of metabolic syndrome research

Authors/year/country	Sample	Metabolic syndrome criteria	Study design	Intervention	Control
Cohen et al., 2008 USA	26 sedentary overweight adults with metabolic syndrome aged 30–65 years	NCEP criteria	RCT with gender and race (white vs. non-white) stratified	Restorative yoga (warm-up stretches and breathing exercises followed by 10 poses that were held for 5–10 min each) 15 sessions of 90-min yoga program over 10 weeks	Waitlist control
Corey et al., 2014 USA	171 adults with metabolic syndrome aged 21–65 years	IDF	Multi-center RCT (6-month intervention + 6-month maintenance)	(A) Restorative yoga (relaxation): twice-weekly 90-min classes for 12 weeks + once weekly for 12-24 weeks + once monthly for 24 weeks (B) Home practice recommended (at least 3 times per week for at least 30 min session) (C) Handouts with pictures + DVDs	Low impact stretch led by certified personal trainer or licensed physical therapist
Hegde et al., 2013 India	29 pre-diabetic patients aged 30–75 years	Impaired fasting glucose and/or impaired glucose tolerance	RCT	Yoga (asanas, followed by pranayama and savasana) 75–90 min/day for 5 days for 3 months	Waitlist control

Hunter et al., 2013 USA	29 people 14 younger (32 ± 10 years) with a normal BMI and 15 older (46 ± 12 years) obese with a BMI > 30 kg/m^2	Glucose intolerance	Pre and post	Bikram yoga (Hatha + thermal therapy) 90 min, 3/week for 8 weeks Participants were asked not to change their PA and usual diet	None
Kanaya et al., 2014 USA	180 sedentary people with metabolic syndrome aged 21–65 years	IDF	RCT with gender and race (white vs. minority) stratified	(A) Restorative yoga: 90-min group session (2/week for 12 weeks + weekly for 12 weeks + 24-week maintenance period) (B) 30-min didactic presentation on healthy lifestyle including nutrition	Stretchin (27 seated or standing stretches
Kim et al., 2013 South Korea	41 females with metabolic syndrome aged 30–60 years	NCEP ATP III	RCT	Hatha yoga 60 min twice weekly for 12 weeks	Waitlisted control

Yang et al., 2011 USA	23 adults at high risk for type 2 diabetes aged 45–65 years	High risk was defined: non-exercise (no more than 30 min twice per week) + having family history of T2DM + one of cardiometabolic risk factors (impaired fasting glucose, prehypertension, overweight, and abnormal total cholesterol)	RCT	Vinyasa style yoga 60 min twice per week for 3 months	Health educatio (every 2 weeks fo 3 months

BP: blood pressure; HDL:high-density lipoprotein; IDF (International Diabetes Federation): abdominal obesity and any two of the following four factors—increased triglycerides or treatment thereof, reduced HDL cholesterol or treatment, increased blood pressure or treatment, raised fasting plasma glucose or previously diagnosed diabetes; NCEP (National Cholesterol Education Program): three or more of the following—raised fasting plasma glucose, elevated blood pressure, elevated triglycerides, reduced HDL, and abdominal obesity; NCEP ATP III: National Cholesterol Education Program Adult Treatment Panel III; PA: physical activity; RCT: randomized controlled trial.

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METABOLIC SYNDROME AND WEIGHT CONTROL: CLINICAL INSIGHTS

TIMOTHY MC CALL IN COLLABORATION WITH THE CONSULTING YOGA TEACHERS AND YOGA THERAPISTS

According to Carrie Demers, the imbalances seen in metabolic syndrome, central obesity, lipid abnormalities, hypertension, and insulin resistance "are primarily a reaction to modern living that includes sedentary lifestyle, poor food quality, and high stress. Typically, people with metabolic syndrome are not very conscious of their bodies or the effects of the lifestyle choices they are making." In addition, it is common for people with metabolic syndrome to have, as described in Ayurveda, an increase in *kapha dosha.*

Demers stresses the value of practices that increase physical activity to address what she sees as "the major need for this group." These could be vigorous asana, "but I let people choose what kind of activity is appealing. For some it is yoga, for others it's walking, dance, or swimming." If it's yoga, she suggests "a steady practice that gradually increases in intensity over time, to include prone back bends, twists, and *agni sara* (see Fig. 12.1)." In agni sara, the abdomen is repeatedly drawn up and in while the breath is held after a full exhalation. In addition, she often incorporates *kapalabhati* (breath of fire) and *bhastrika* (bellows breath) pranayama into her recommendations, to help reduce kapha and further build *agni* (digestive fire).

Demers asks these students in their yoga practice to focus on “movement with awareness, which gradually strengthens the connection to and appreciation for the body.” Breath awareness and breath training, she says, lower sympathetic tone and increase mental calm. “From this calmer place, people are able to make better choices about food, activity, substance use, schedule, and so on.”

In this population, Demers says, “Positive self-talk is an important part of a yoga practice. It helps loosen the attachment to habitual negative thinking and encourages the valuing of self. This valuing then supports better choices, and as the person sees that the body can improve, a real appreciation for—or even love of—the body arises. Over time, they (we!) begin to see the incredible healing power and resilience inherent in themselves, which is empowering and joyous.”

Figure 12.1

Agni sara , a yogic practice said to build the digestive fire and decrease *kapha* .

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”There are a lot of misconceptions about yoga and weight loss,” says Timothy McCall. “People have this notion that a strong practice, or a sweaty class done in a hot room, will burn a huge number of calories, but the effect actually turns out to be pretty modest, not much more than a brisk walk. And it is not about revving up your metabolism to burn more calories either, a mistaken notion that some yoga teachers have, unfortunately, propagated.”

”Paradoxically,” McCall says, “it appears that often the slower, gentler, more relaxing practices may be more effective at promoting weight loss. Yoga’s demonstrated ability to combat stress and lower elevated levels of cortisol is part of the story. Perhaps even more important is yoga’s focus on mindfulness, including greater awareness of what and how we eat and how it affects us,” he says. “We cultivate that mindfulness on our yoga mats and meditation cushions, and it starts to spread out into other areas of our lives. Many people who overeat do so mindlessly, some of them barely even tasting their food, so I try to encourage students to turn their meals into more of a meditation.”

McCall says, “I suggest people initially try this for a single meal. Create a nice ambience, turn off the TV, and, if possible, the phone, and please sit down to eat. Chew slowly, pausing between bites. Notice the taste, smell, and texture of the food and how your body changes as you eat it. Stay aware of the movement of your breath in your nostrils, trying to keep it slow and smooth and regular. As when meditating, if you find yourself slipping into thought, just notice that and return your attention to the food as well as your body's response to it. When you do this, you'll enjoy your meal more and start to notice the initially subtle clues that you're getting full, much sooner than you otherwise might."

"It's not like there's some magic yoga practice for weight loss," McCall says. "I think it's more that you practice yoga regularly and progressively deepen that habit pattern, or *samskara* . With the practice comes growing awareness of your internal states, body, mind, and emotions, and this can lead to better choices. When you notice that you feel better when you do your practice or that you feel groggy or irritable when you overeat—that turns out to be much more motivating than someone telling you that you're going to die if you don't lose weight."

Figure 12.2

Arm balances, and even poses like downward-facing dog, can place too much weight on the wrists for some overweight students. In this variation, wall ropes placed around the upper thighs reduce the weight on the arms, and help facilitate decompression of the spine.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

McCall finds that Ayurveda offers an important perspective on weight loss. He says, “If someone’s overweight is associated with the inertia of imbalanced kapha, I’d try to challenge them with a strong practice, but in a way that the risk of injury is minimal, by avoiding jumping from pose to pose, most inversions, and any pose that puts too much weight on particular joints” (see Fig. 12.2).

But if the patient’s weight gain is related to excessive *vata* , and he says he’s seeing a lot of that these days, then “they are likely already moving too fast and doing too much. Typical weight-loss strategies of vigorous exercise and low-fat diets may only serve to exacerbate the vata imbalance, paradoxically frustrating their efforts to drop weight. Indeed, Ayurveda teaches that well-cooked, unctuous food calms vata—particularly when mealtimes are stable day to day. What these patients need more than anything is to recharge their batteries. It’s amazing how in people who are often desperate to lose weight and convinced they need demanding workouts to succeed, deep relaxation and meditation may accomplish what diet and exercise alone could not.”

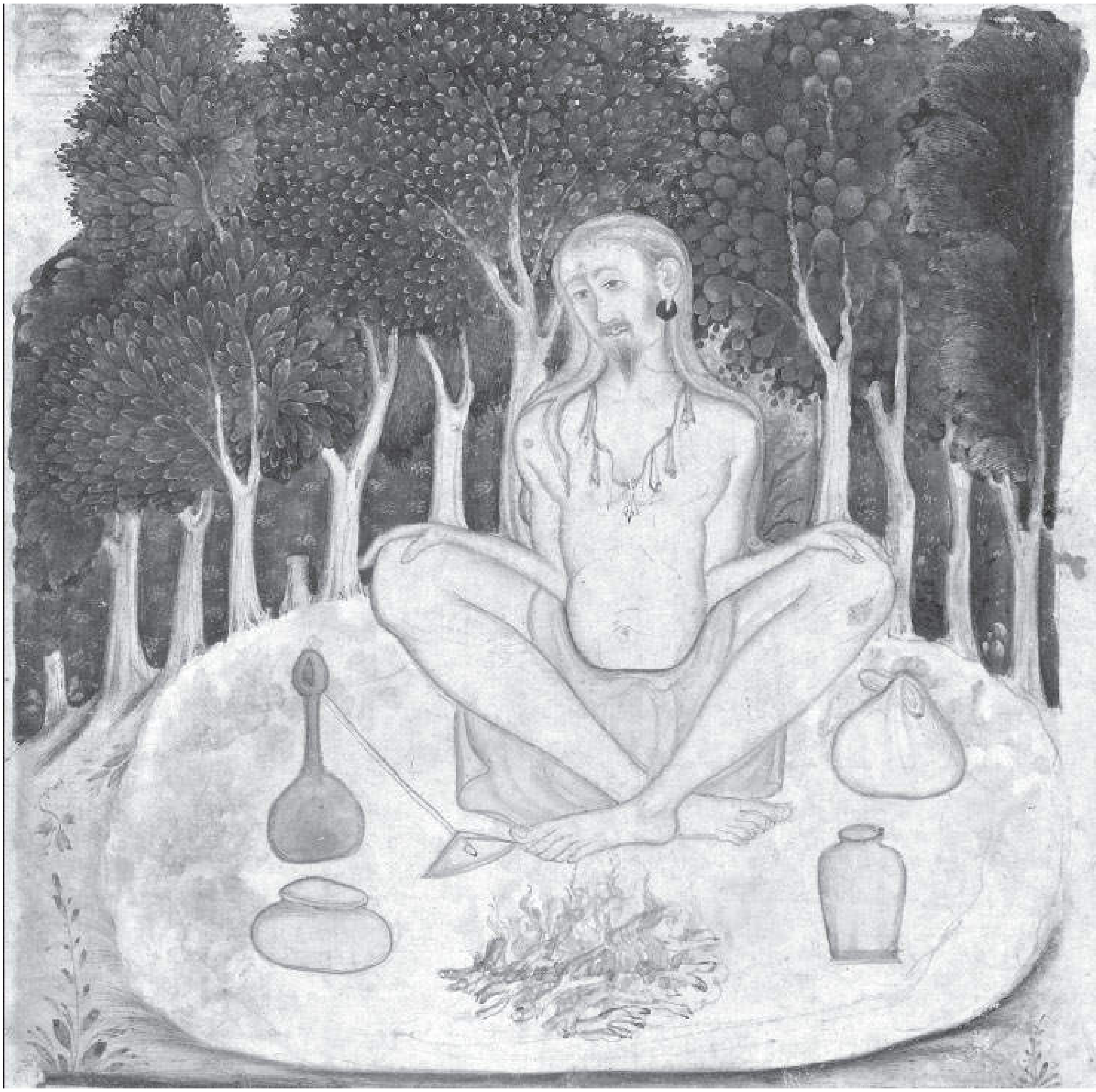
Resources

Book: *Yoga as Medicine* by Timothy McCall

Book: *Yoga for Health and Healing* by Ananda Balayogi

SECTION 5

CARDIORESPIRATORY CONDITIONS



From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.25a. © The Trustees of the Chester Beatty Library, Ireland.

CHAPTER THIRTEEN

YOGA THERAPY FOR HEART DISEASE

A KANMANTHAREDDY • K MADAN • SC MANCHANDA • D LAKKIREDDY

Introduction

Global burden of cardiovascular disease

Cardiovascular disease (CVD) encompasses a broad spectrum of illnesses comprising hypertension, atherosclerosis, heart disease, stroke, peripheral vascular disease, and aortic vascular disease and their associated complications. CVD is the leading cause of mortality worldwide. In 2008 alone, greater than 17 million deaths (30% of total deaths) worldwide were attributed to CVD (Mendis, Puska, & Norrving, 2011). More worrisome is the fact that 3 million of these deaths occurred in people younger than 60 years (Mendis et al., 2011). CVD is not only a leading cause of mortality but also a leading cause of morbidity and disability. The World Health Organization estimates that 293 million disability-adjusted life years (DALYs) were lost due to CVD, accounting for 11% of all DALYs lost in the year 2008 (Mendis et al., 2011). Whereas CVD mortality is decreasing in many high-income countries, now many low- and middle-income countries are witnessing an alarming and accelerating increase in CVD rates, resulting in huge economic burden to society (Mendis et al., 2011). There has been tremendous progress in programs aimed at prevention of CVD in addition to improvements in medications and therapeutic options available for its treatment. However, these efforts are not without limitations, and the implementation of these programs remains a challenge, especially in low- and middle-income countries. Hence, cost-effective strategies to prevent CVD and supplement the current treatment options are required. Yoga may be one such cost-effective strategy to prevent CVD (Manchanda, 2014). This chapter focuses on yoga in the management of heart disease, peripheral vascular disease, and stroke.

Review of evidence and search strategy

We reviewed PubMed and Google Scholar databases for studies using search terms “yoga,” “cardiovascular disease,” “hyperlipidemia,” “metabolic syndrome,” “smoking cessation,” “hypertension,” “smoking,” “inflammation,” “atherosclerosis,” “coronary artery disease,” “angina,” “myocardial infarction,” “stroke,” “heart failure,” “cardiomyopathy,” “cardiac rehabilitation,” “arrhythmias,” “atrial fibrillation,” “supraventricular arrhythmias,” “ventricular arrhythmias,” and “premature ventricular contractions.” The identified studies were then evaluated for the type of study. Highest accordance was given to randomized controlled studies (RCTs); meta-analyses; prospective, retrospective, or observational studies; and case reports, in that order. Individual elements of the chosen studies were then described in detail as needed in this chapter.

Pathophysiology of cardiovascular disease

Our understanding of the pathophysiology of CVD has expanded considerably in recent years. Several pathophysiological pathways have been identified, though there are still a number of processes that remain to be clarified. Dzau et al. (2006) came up with a concept called the "CVD continuum," which describes CVD as a chain of events initiated by several risk factors such as dyslipidemia, hypertension, diabetes mellitus, smoking, and obesity (Dzau et al., 2006). These risk factors are known to promote oxidative stress and to cause endothelial dysfunction, initiating a cascade of events that include alterations in vasoactive mediators, inflammatory responses, and vascular remodeling, culminating in target-organ pathology (Fig. 13.1). Any interruption along this chain of events may interrupt the pathological processes, thus conferring cardiovascular protection. Yoga has the potential to act at several levels of this chain of pathophysiological events, which are reviewed in this chapter along with the use of yoga in the management of cardiovascular conditions.

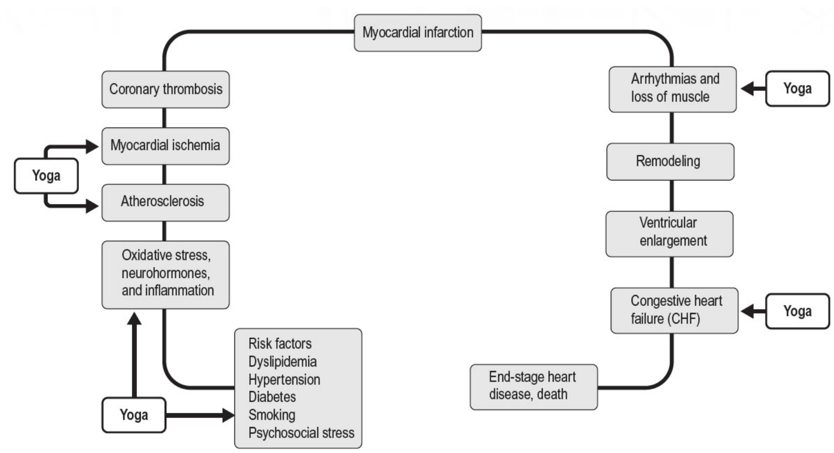


Figure 13.1
The cardiovascular disease continuum and the potential role of yoga.
Adapted from Dzau et al., 2006

Psychophysiological rationale for the use of yoga in heart disease

Psychosocial stress and negative affective states have emerged as significant risk factors for hypertension, stroke, dyslipidemia, myocardial infarction, insulin resistance, and cardiovascular mortality (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Vitaliano et al., 2002). There is strong evidence that yoga can reduce stress and lead to improvement in both CV response and recovery from stress (Mezzacappa, Kelsey, Katkin, & Sloan, 2001; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). Streeter et al. (2012) have recently proposed a theory to explain the benefits of yoga in diverse, frequently comorbid medical conditions based on the concept that yoga reduces allostatic load in stress-response systems so that optimal homeostasis is restored. They hypothesized that stress produces an:

- Imbalance of the autonomic nervous system with decreased parasympathetic and increased sympathetic activity;
- Underactivity of the gamma-aminobutyric acid (GABA) system, the primary inhibitory neurotransmitter system; and
- Increased allostatic load.

The authors further postulated that yoga-based practices correct underactivity of the PNS and GABA systems in part through stimulation of the vagus nerves, the main peripheral pathway of the PNS, and thereby reduce allostatic load. Innes et al. (Innes, Bourguignon, & Taylor, 2005), in an exhaustive review, had earlier postulated two interconnected pathways by which yoga reduces the risk of cardiovascular diseases through the mechanisms of parasympathetic activation coupled with decreased reactivity of sympathoadrenal system and the hypothalamic–pituitary–adrenal (HPA) axis (Fig. 13.2). This review of numerous studies suggests that yoga promotes a reduction of sympathetic activation, an enhancement of cardiovagal function, and a shift in autonomic nervous system balance from primarily sympathetic to parasympathetic, as shown by significant reduction in heart and respiratory rate, cortisol concentration, catecholamine levels, rennin activity, skin conductance, and cardiovascular response to stress as well as significant increases in heart rate variability (HRV) and baroreflex sensitivity (Innes et al., 2005). Low heart rate variability and baroreflex sensitivity reflect impaired cardiovagal adaptability and suggest insufficient parasympathetic tone. These alterations are in turn strong independent predictors of cardiovascular morbidity and mortality. In contrast, high HRV and baroreflex sensitivity are generally considered to indicate good cardiovagal adaptations and sympathovagal balance, permitting greater responsibility and sensitivity to changes in environmental demands. These alterations in neurohumoral activity confer a protective effect against CHD, hypertension, arrhythmias, and heart failure. Moreover, patients with heart disease also suffer from several psychiatric comorbidities such as depression and anxiety (Feola et al., 2013; Musselman, Evans, & Nemeroff, 1998). Conversely, depression and anxiety increase the risk of ischemic heart disease and congestive heart failure (Musselman et al., 1998). Multiple studies have demonstrated improvement in depression, anxiety, and mood with yoga therapy and are discussed in detail in different chapters of this book.

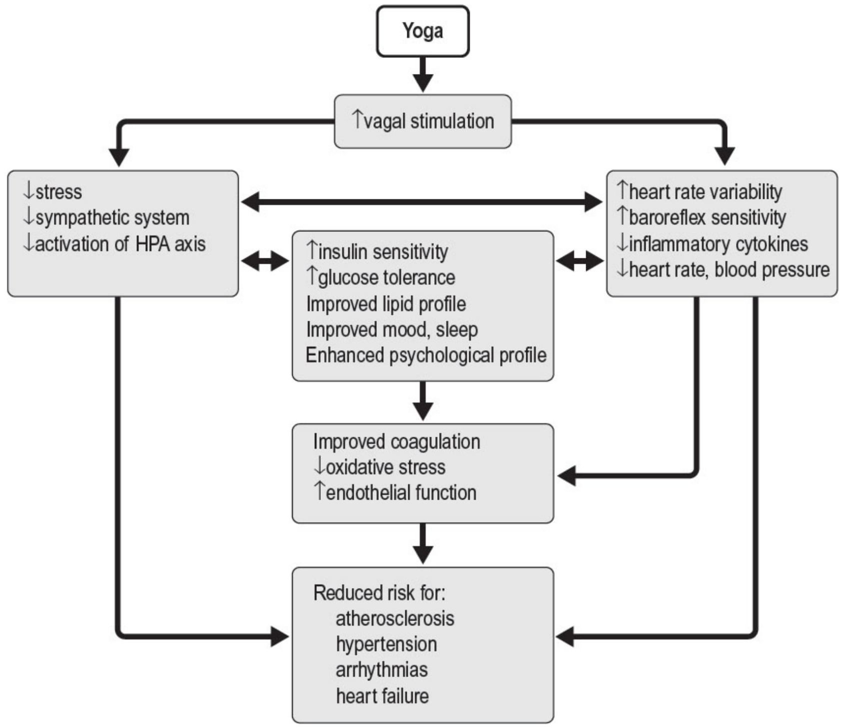


Figure 13.2
Psychophysiology of yoga in heart disease: possible mechanisms.
Adapted from Innes et al., 2005

Yoga for control of risk factors for cardiovascular disease

Several studies suggest that regular yoga-based short- and long-term practices can significantly improve CVD risk factors such as lipid profile, blood pressure, type 2 diabetes mellitus (T2DM), smoking, obesity, and psychosocial stress (Bijlani et al., 2005; Mahajan, Reddy, & Sachdeva, 1999; Manchanda & Madan, 2014; Schmidt, Wijga, Von Zur Muhlen, Brabant, & Wagner, 1997). Below, we discuss the role of yoga in improving lipid profile. The role of yoga in improving blood pressure, T2DM, obesity, metabolic syndrome, and psychosocial stress are discussed in separate chapters in this book.

Lipid profile

Dyslipidemia—high total cholesterol (Tc), low-density lipoprotein (LDL), and triglycerides (Tg) and low high-density lipoprotein (HDL)—is the leading risk factor for CHD. Worldwide dyslipidemia accounts for 56% of CHD cases and 18% of strokes, amounting to about 4.4 million deaths annually (Mendis et al., 2011). Several studies have demonstrated that reduction of high cholesterol can significantly reduce heart disease (Thomopoulos, Skalis, Michalopoulou, Tsioufis, & Makris, 2015). A 10% decrease in total cholesterol can result in 50% reduction in CHD over 5 years. Yoga has been thought to improve metabolic profile and thereby result in improved blood pressure, blood glucose, and lipid profiles. This theory has been tested in multiple clinical studies with mixed results (Table 13.1 , p. 287). Joseph et al. (1981) studied the effects of yoga training comprising 22 asanas in 10 healthy subjects for 3 months. They observed a significant decrease in blood cholesterol levels, from 170.40 ± 5.23 to 154.50 ± 4.21 (p < .001). In a nonrandomized controlled clinical trial, Schmidt et al. (1997) found a significant decrease in total and LDL cholesterol (8.2% and 12.8% respectively) in healthy adults after 3 months of residential training in Kriya yoga. Mahajan et al., in an RCT of 93 subjects with CVD, showed a decrease of total cholesterol by 21%, triglycerides by 28.5%, and LDL by 19.1% after 14 weeks of yoga practice; however, HDL was not altered (Mahajan et al., 1999). In metabolic syndrome, significant decrease in Tc, LDL, and Tg and increase in HDL has also been shown after 12 months of a yoga intervention in an RCT (Manchanda, Mehrotra, Makhija, Mohanty, & Dhawan, 2013). Several other randomized and nonrandomized studies also demonstrate improved lipid profile through yoga practice for 6 weeks to 2 years in patients with T2DM, hypertension, and coronary artery disease (CAD) (see Table 13.1 , p. 287). However, many of the studies also modified the diet (Bijlani et al., 2005; Manchanda et al., 2013; Manchanda et al., 2000; Ornish et al., 1990; Shantakumari, Sequeira, & El deeb, 2013; Yogendra et al., 2004). Therefore, the effects of diet on lipids cannot be separated out from the effects of yoga. One study by Ornish et al. (1990) utilized intensive lifestyle changes, including a low-fat vegetarian diet, exercise, and stress management with moderate yoga exercise, pranayama, and asanas. In fact, some studies suggest that a yogic lifestyle should include diet control, physical exercise, tobacco avoidance, and stress management (Manchanda et al., 2013; Manchanda et al., 2000).

The most recent meta-analysis of all RCTs evaluating the efficacy of yoga on lipid profile demonstrated that LDL cholesterol decreased by an average of 12 mg/dL (95% CI 2.5–22 mg/dL) across all studies with yoga therapy compared to control subjects (Chu, Gotink, Yeh, Goldie, & Hunink, 2016). A total of 13 studies with 751 subjects were included in this meta-analysis, of which 384 were enrolled in a yoga group. More specifically, the meta-analysis explored the effect of yoga in patients with established CAD as well as risk factors for CAD. However, there was no benefit of yoga therapy in the subgroup of patients with established CAD. The mean difference was 0.36 mg/dL (p = .99) between the yoga and non-yoga groups (Chu et al., 2016). However, the authors observed that the lack of benefit in this subgroup was due to the inclusion of a study by Jatuporn et al. (2003). In this study, yoga therapy was compared to drugs, and as expected drug therapy outperformed yoga therapy (Jatuporn et al., 2003). Further, there was a heterogeneous mix of studies and the definition of yoga therapy varied.

At this time there is not enough evidence to suggest replacement of high-intensity statin therapy with yoga therapy for improving lipid profile. However, the role of yoga as a complementary option to currently available lipid lowering therapies is unknown and warrants further investigation.

Tobacco

Tobacco use is the most preventable cause of the death in the world. Over 1.3 billion people use tobacco worldwide and more than 80% of tobacco use occurs in low- and middle-income countries (Mendis et al., 2011). All types of tobacco use—cigarettes, hookah, pipes, other smoking tobacco forms, and smokeless tobacco—are associated with CHD risk. Even secondhand smoke is a well-documented risk factor for CHD. Quitting smoking is a challenging task, often with poor success. Some randomized and nonrandomized studies suggest that different types of yoga intervention alone or with behavior therapy may be able to enhance quitting smoking rates (Table 13.2 , p. 290). Bock et al. (2012) studied 55 women with a twice-weekly program of yoga for 8 weeks. They demonstrated increased odds of 24-hour smoking cessation compared with a wellness group. At 3- and 6-month follow-up, participants of the yoga group continued to show greater rates of abstinence compared with those in control group. Kochupillai et al. (2005) studied the effect of Sudarshan Kriya and pranayama in a structured workshop for 6 days in 82 subjects. At the end of the workshop, 65% remained without tobacco for 6 days and the remainder showed a reduction of 50% to 90%. In 21% of the individuals who were followed for 6 months, the yoga practices helped in control of tobacco habits. Two meta-analyses also suggested that a yoga intervention holds promise as a complementary therapy for smoking cessation (Carim-Todd, Mitchell, & Oken, 2013; Dai & Sharma, 2014). However, the follow-up was short, from 8 weeks to 6 months. Long-term and well-randomized studies are needed to further assess the efficacy of yoga.

Inflammation, oxidative stress, and procoagulant status

Accumulating data suggest that inflammation contributes to the causation and progression of CVD (Sarvottam, Magan, Yadav, Mehta, & Mahapatra, 2013; Taube, Schlich, Sell, Eckardt, & Eckel, 2012). In addition, inflammatory mediators may trigger rupture of atherosclerotic plaque, resulting in coronary thrombosis and acute ischemia. The key inflammatory markers that have gained recognition include IL-6, fibrinogen, C-reactive protein, and TNF-alpha, all of which have been considered as independent predictors of CHD. Adiponectin, an important regulator of endothelial nitric oxide synthase, is a key determinant of endothelial function and is cardioprotective.

Free radicals play a key role in the pathogenesis of atherosclerosis, diabetes, and vascular disease. Antioxidants scavenge the free radicals and are therefore believed to decrease oxidative stress and inflammation. Several antioxidants such as malondialdehyde (MDA), superoxide disumutase (SOD), glutathione, and vitamin E are well recognized for their antioxidative role and have been used as surrogate markers in cardiovascular disease. The effect of yoga on these biomarkers has been studied by few investigators. Bhattacharya et al., in a prospective age- and sex-matched study, enrolled 30 young male participants between 18 and 21 years of age who were given training in yogic breathing exercises and relaxation techniques for 30 minutes daily for 10 weeks (Bhattacharya, Pandey, & Verma, 2002). The lipid peroxide MDA content decreased significantly, from 9.57 ± 0.56 mmol/L to 8.21 ± 0.76 mmol/L ($p < .01$), in the yoga group whereas the control group showed no change, suggesting that there was a decrease in the production of free radicals following yoga practice. Though the SOD levels increased, this did not achieve statistical significance. Similarly, Singh et al., in patients with T2DM, showed a significant decrease in MDA and HbA1C levels after 40 days of training in several yoga asanas (Singh et al., 2001). Jatuporn et al. (2003) also observed in an RCT of 44 patients with CHD that 4 months of a yoga-based intensive lifestyle program resulted in a statistically significant increase in plasma total antioxidants, plasma vitamin E, and erythrocyte glutathione (GSH) compared to controls. However, MDA was not altered. Yadav et al. measured the concentration of thiobarbituric acid reactive substances (TBARS) in the blood as an indicator of oxidative stress in the beginning and at the end of a 10-day comprehensive yoga-based lifestyle-modification program in 104 subjects (mean age 41.2 ± 14.6 years) and observed that the concentration of TBARS decreased significantly, from 1.72 ± 0.72 to 1.57 ± 0.72 nmoles/mL ($p < .05$), suggesting that a brief yoga-based intervention may reduce oxidative stress (Yadav, Ray, Vempati, & Bijlani, 2005).

Procoagulant changes caused by oxidative stress have a pivotal role in the development and progression of CVD, metabolic syndrome, and diabetes (Ceriello & Motz, 2004). In two uncontrolled studies in healthy adults it was observed that 12–16 weeks of yoga practices resulted in a significant decline in fibrinogen and an increase in fibrinolytic activity (Chohan, Nayar, Thomas, & Geetha, 1984; Schmidt et al., 1997), suggesting that yoga may foster beneficial changes in the coagulation and fibrinogen systems. However, the studies were not randomized, a small number of subjects were studied, and the follow-up was short.

Sarvottam et al. (2013) studied the short-term effects of a yoga-based lifestyle on markers of inflammation and endothelial function in 51 obese individuals. After 10 days of a daily yoga intervention, the researchers observed a significant reduction in BMI (body mass index), a significant reduction in plasma IL-6, and an increase in plasma adiponectin, suggesting that even a short-term yoga-based program may reduce the risk for CVD as indicated by weight loss and decrease in inflammatory markers (Sarvottam et al., 2013). However, this was a nonrandomized study and also used diet and exercise in addition to yoga. Therefore, the results have to be interpreted cautiously.

Regression of atherosclerosis

A few controlled trials have studied the effect of a yoga-based lifestyle in early and advanced atherosclerosis. In an RCT, Manchanda and colleagues demonstrated that a 1-hour practice of yoga (asanas, pranayamas, and meditation) for 1 year reduced carotid intimal thickness in patients with metabolic syndrome as compared to controls, suggesting that early atherosclerosis may be retarded by yoga practices (Manchanda et al., 2013). In addition, central obesity, blood pressure, LDL, and HDL were also favorably altered more in the yoga group than the conventional lifestyle-modification group. Four other controlled studies utilizing coronary angiography in advanced atherosclerotic CHD have demonstrated that regular practice of yoga for 1–2 years with the use of a low-fat vegetarian diet caused retardation and/or regression of coronary stenosis as compared to the usual-care group. Ornish and co-workers, in patients with average coronary stenosis of about 40 ± 16.9%, showed a regression through a yoga-based intensive lifestyle intervention to 37.8 ± 16.5% as compared to controls in which the stenosis increased from 42.7 ± 15.5% to 46.1 ± 18.5% ($p < .01$) (Ornish et al., 1990). As part of what Ornish et al. called an "intensive lifestyle intervention," they utilized yogic techniques such as stretching exercises, breathing techniques, meditation, progressive relaxation, and imagery. Manchanda et al. (2000), in another RTC with participants who had more advanced atherosclerotic lesions (≥ 70% stenosis in one or more coronary arteries), observed that a yoga lifestyle intervention for 1 year retarded the progression of, or even regressed, advanced atherosclerotic obstructive coronary lesions. Coronary stenosis decreased from 62.4 ± 14.5% to 60.9 ± 16.0% in the yoga group versus increase from 59.7 ± 17.7% to 68.4 ± 16.0% in controls ($p < .01$). Similarly, Yogendra et al. (2004), in a prospective controlled open trial observed that in 113 patients with CHD, a yoga lifestyle intervention for 1 year caused regression, arrest of progression, and decrease in ischemia by myocardial perfusion imaging. Recently, Gupta et al., in a nonrandomized study of 123 patients with CAD, showed similar regression in advanced coronary atherosclerosis through raja yoga practice for 2 years, especially in patients who adhered to the program (Gupta et al., 2011). In the most-adherent group, coronary luminal diameter decreased from 70.06 ± 8.09% to 50.0 ± 13.84%, whereas in the least-adherent group it increased from 62.47 ± 18.51% to 73.03 ± 17.53% ($p < .001$). In all four studies, lipid profiles, body weight, mental stress, ischemia, and the need for interventional medical procedures were also significantly reduced as compared to controls. All the studies reported good compliance with yoga practices, and no adverse effects were reported. However, in addition to yoga, all these studies also utilized diet control and exercise, and therefore the effect of yoga alone in these studies has to be interpreted cautiously.

Cardiac rehabilitation

Cardiac rehabilitation has been shown to be beneficial in the recovery process after myocardial infarction (MI), coronary bypass surgery, and coronary interventions. Adding a psychosocial intervention in the rehabilitation program improves the quality of life and decreases mortality (Linden, Stossel, & Maurice, 1996). Yoga practices may lead to similar outcomes as cardiac rehabilitation, such as improved general well-being, better sleep and appetite, improved physical fitness, stress reduction, and lifestyle change and hence yoga may be ideally suitable for cardiac rehabilitation (Telles & Naveen, 1997). Tulpule & Tulpule (1980) in an RCT compared the effect of a 1-year yoga-based cardiac rehabilitation intervention in 102 post-MI patients as compared to a conventional-treatment group. The researchers reported that more patients were able to resume work within 6 months in the yoga group than in the control group. They also observed decreased mortality in the yoga group versus the control group during the study period. Recently, a single-blind prospective randomized parallel two-armed active control study evaluated yoga-based cardiac rehabilitation after coronary artery bypass surgery in 250 patients for 1 year (Raghuram et al., 2014). In this study, a significant decrease in perceived stress, anxiety, depression, and negative affect was observed in the yoga group, while in the control group there was an increase in the score of anxiety. The researchers also observed greater improvement in the yoga group in left ventricular ejection fraction (LVEF); a reduction in BMI, blood glucose, and LDL; and an increase in HDL as compared to the controls.

Silberman et al. (2010) studied the effectiveness and efficacy of a yoga-based intensive cardiac rehabilitation program in 2,974 men and women from 24 socioeconomically diverse sites. They observed a significant decrease in BMI, triglycerides, LDL, HbA1c, blood pressure, depression, and hostility and also an increase in exercise and functional capacity. They concluded that the yoga-based cardiac rehabilitation program was feasible and sustainable for most patients who enrolled and was associated with numerous subjective and objective improvements in health outcomes.

Yoga and arrhythmias

Atrial fibrillation

Yoga therapy has been found to decrease atrial fibrillation (AF) burden in patients with paroxysmal AF (Lakkireddy et al., 2013). In this study, 52 patients were enrolled and 49 completed it. The study subjects participated in yoga training for 60 minutes a day, twice a week, for a period of 3 months (Lakkireddy et al., 2013). At the end of the follow-up period there was significant improvement in symptomatic and nonsymptomatic AF episodes. The symptomatic AF episodes decreased from 3.8 ± 3 to 2.1 ± 2.6; $p < .001$. Similarly, the nonsymptomatic AF episodes decreased from 0.12 ± 0.44 vs. 0.04 ± 0.20; $p < .001$. There was also reduction in symptomatic non-AF episodes: 2.9 ± 3.4 vs. 1.4 ± 2.0; $p < 0.001$. In addition to decreasing the burden of AF, there was improvement in several domains of quality of life such as physical functioning, general health, vitality, social functioning, depression, anxiety, and mental functioning (Lakkireddy et al., 2013).

The autonomic nervous system plays a key role in the pathogenesis of AF. Parasympathetic overdrive is thought to result in “non-uniform shortening of the atrial refractory period” resulting in formation of the reentry substrate in the left atrium (Arora, 2012; Nemirovsky, Hutter, & Gomes, 2008). In addition, focal triggers emerge in the left atrium from parasympathetic overdrive (Arora, 2012; Nemirovsky et al., 2008). Other investigators have proposed that both the sympathetic and the parasympathetic nervous system contribute in the genesis of AF (Amar, Zhang, Miodownik, & Kadish, 2003). The benefits of yoga therapy in AF as seen in Lakkireddy et al. (2013) are thought to be due to restoration of sympathetic and parasympathetic balance at the level of hypothalamic–pituitary–adrenal axis. Besides restoring sympathetic and parasympathetic balance, yoga is thought to decrease inflammation and oxidative stress, and this results in suppression of atrial remodeling, micro-reentry circuits, and triggers for AF (Lakkireddy et al., 2013). However, the exact mechanism by which yoga suppresses AF remains unknown.

Supraventricular arrhythmias

There are no reports of use of yoga in the treatment of other supraventricular arrhythmias. Theoretically, it may be of use in several of these arrhythmias as well as those described in this section. Increased parasympathetic tone from regular yoga training may suppress ectopy and may decrease the frequency of symptoms in patients with paroxysmal supraventricular tachyarrhythmias.

Ventricular arrhythmias

There are a few case reports of suppression of ventricular ectopic beats following yoga therapy. Ravindra, Madanmohan, & Pavithran et al. (2006), in their case series of two patients, reported that pranayama and corpse pose were effective in decreasing the frequency of premature ventricular contractions following 2 months of yoga training. In another prospective study of 10 patients, deep breathing at 6 breaths per minute decreased the frequency of premature ventricular contractions by 50% in half of the study subjects (Prakash, Ravindra, Madanmohan, Anilkumar, & Balachander, 2006). This suppression of premature ventricular contractions is thought to be due to alteration of the ANS with increased parasympathetic activity resulting in modulation of the sino-atrial and atrio-ventricular node (Prakash et al., 2006). It has been shown in several studies that altered autonomic output increases HRV and dispersion of the QT interval, which in turn can result in ventricular arrhythmias (La Rovere, Bigger, Marcus, Mortara, & Schwartz, 1998; Schwartz, La Rovere, & Vanoli, 1992). It has also been hypothesized that autonomic modulation from yoga results in decreasing the QT interval dispersion, and this may therefore suppress the ventricular arrhythmias (Yetkin, Aksoy, Yetkin, & Turhan, 2006). Restoration of autonomic balance along with decrease in the QT dispersion is thought to decrease the ectopy originating from the ventricles.

Effect of yoga on left ventricular dysfunction

The effect of yoga has been evaluated as a complementary treatment option in patients with heart failure. Krishna et al. (2014) evaluated the benefits of yoga in patients with heart failure in 130 patients; 44 and 48 patients in the yoga and control groups, respectively, completed the study. Patients with either systolic or diastolic heart failure and New York Heart Association class I or II symptoms were included in this study. After 60 minutes of yoga 6 times a week for 12 weeks, there was a significant improvement in the left ventricular ejection fraction and a decrease in N-terminal pro-BNP levels (Krishna et al., 2014). The left ventricular ejection fraction improved from 38.93 ± 5.1% to 52.96 ± 6.01%; $p < .01$ in the yoga group and from 39.65 ± 5.25% to 45.83 ± 5.68%; $p < .01$ in the control group (Krishna et al., 2014). The N-terminal pro-BNP levels decreased from 3965.48 pg/mL ± 1365.08 to 1395 ± 997.08 pg/mL; $p < .01$ in yoga group and 5495.47 pg/mL ± 1382.50 to 4722.62 ± 1924.70 pg/mL; $p < .05$ in the control group (Krishna et al., 2014). This study strongly suggested that there is a great benefit of yoga therapy as an adjunct to medical treatment in the management of patients with heart failure.

More recently, a meta-analysis of two RCTs showed similar benefits in patients with heart failure (Gomes-Neto, Rodrigues-Jr, Silva-Jr, & Carvalho, 2014). Both peak oxygen consumption and quality of life improved following yoga therapy compared to controls (Gomes-Neto et al., 2014; Pullen et al., 2008; Pullen et al., 2010). In the first study, patients with left ventricular ejection fraction < 50% and NYHA class I-III were randomized to yoga ($n = 9$) and control groups ($n = 10$) and were followed for 2 months (Pullen et al., 2008). Peak oxygen consumption in the yoga group increased from 16.4 ± 5.4 to 19.7 ± 5.0 mL/kg/min ($p = .02$) and treadmill time increased from 476 ± 219 to 578 ± 193 seconds (p

= .002) with no changes or decreases in the control group (Pullen et al., 2008). In a follow-up RCT in African American patients with heart failure, 21 patients were randomized to the yoga group and 19 to the control group (Pullen et al., 2010). There was an increase in peak oxygen consumption from 15.3 ± 5.6 to 18.4 ± 5.1 mL/kg/min ($p < .0001$) in the yoga group and treadmill time also increased by 22% (Pullen et al., 2010). The improvements in peak oxygen consumption and treadmill time also correlated positively with improvements in quality of life scores in both the above studies (Pullen et al., 2008; Pullen et al., 2010). In addition to the direct benefit of improved pump function with the use of yoga training there are other beneficial effects such as weight loss and improvement in mood and quality of life (Kubo, Hung, & Ritterman, 2011). The researchers observed a mean weight loss of 3.5 lb in patients with congestive heart failure following completion of yoga training (Kubo et al., 2011). Besides improvement in exercise capacity, there was also decrease in inflammatory markers in patients with congestive heart failure after yoga training (Pullen et al., 2008).

The mechanism of action by which yoga therapy helps patients with heart failure is likely due to autonomic nervous system modulation. It has been well established that in patients with heart failure there is sympathetic overdrive and abnormal cardiovascular reflux function (Kishi, 2012). In addition, several circulating neurohormones such as nitric oxide, prostaglandins, endhothelin-1, angiotensin II, arginine vasopressin, aldosterone, and atrial natriuretic peptide contribute to abnormal modulation of the SNS at various levels (Kishi, 2012). Yoga therapy facilitates the balancing of sympathetic and parasympathetic nervous systems and thereby contributes to improvement in symptoms in patients with heart failure. In decompensated patients with heart failure, exercise may not be well tolerated, whereas yoga, which can include gentle asanas and breathing exercises, may be more tolerable for these patients.

Yoga and implantable cardioverter defibrillators

Anxiety and depression are common in patients with implantable cardioverter defibrillators (ICD) (Pedersen, van Domburg, Theuns, Jordaens, & Erdman, 2004; Sears & Conti, 2002). These mood disorders are exacerbated by the fear of being shocked by the device in addition to their cardiovascular condition. The estimated prevalence of anxiety is about 24–87% and depression is about 24–33% in patients with implanted ICDs (Matchett et al., 2009). The anxiety is not limited to around the time of implantation of the ICD device; it has been observed that nearly 50% of the patients who are anxious at baseline continue to be anxious at 12 months (Pedersen et al., 2011). Toise et al. (2014) in an RCT observed that 8 weeks of yoga therapy significantly decreased the levels of shock-related anxiety, and these patients had greater overall self-compassion and mindfulness. Further, they observed that the risk of device-treated ventricular events was 32% lower in the yoga group compared to controls. Therefore, yoga should be considered as a complementary and or supportive therapy in patients with ICDs to promote overall mental and physical health.

Yoga and peripheral vascular disease

Peripheral arterial disease shares common risk factors with CAD. Duren and colleagues evaluated the impact of exercise and yoga on carotid arterial stiffness (Duren, Cress, & McCully, 2008). In this study, carotid distensibility and pulse wave velocities were compared in eight subjects with sedentary lifestyle, eight subjects who practiced yoga for 2 days a week for 1 year prior to testing, and another 10 subjects who performed some kind of aerobic exercise for at least 30 minutes a day for 1 year prior to testing. Carotid artery stiffness as measured by distensibility coefficient was similar in both the yoga and aerobic exercise groups; however, this was significantly higher than the sedentary lifestyle group (Duren et al., 2008). Pulse wave velocities of the carotid artery were similar in the yoga and aerobic exercise groups, and these velocities were lower than the sedentary group subjects (Duren et al., 2008). The above findings demonstrate greater elasticity of the arteries in patients who engage in aerobic exercise or yoga, suggesting that yoga has comparable benefits to exercise (Duren et al., 2008). Reversibility of the carotid intima thickness with yoga therapy was also demonstrated by Manchanda et al. (2013) and has been discussed in detail in the above sections (Manchanda et al., 2013). The role of yoga in other peripheral arterial diseases has not been evaluated. In our opinion, yoga may have the same benefits of arresting progression of atherosclerosis and increasing exercise tolerance in patients with peripheral artery disease as for patients with CAD. There is an ongoing clinical trial evaluating the efficacy of yoga in improving physical function and maximal walking distance in patients with peripheral arterial disease (NCT02007525) (ClinicalTrials, 2015).

Yoga and stroke

Yoga may afford the same benefits of plaque stabilization and arresting atherosclerosis in patients with stroke as seen in individuals with other atherosclerotic disorders. There are no studies reporting the outcomes of stroke in yoga practitioners. Alternatively, yoga may improve physical conditioning and balance in patients with prior stroke. Schmid and colleagues in a pilot study evaluated the impact of yoga on balance (Schmid et al., 2012). In this RCT, 37 patients were enrolled in the yoga group and 10 patients were enrolled in the control group (Schmid et al., 2012). After 8 weeks of yoga therapy, the Berg Balance score improved in the yoga group from 41.3 ± 11.7 to 46.3 ± 9.1 ($p < .001$). The fear of falling score decreased from 51% to 46% ($p < .001$). The likely benefit of yoga in these patients is probably due to improved conditioning. Further studies are recommended to evaluate the benefits of yoga in stroke patients.

Limitations of yoga studies

Though several published studies have demonstrated that yoga is useful in primary and secondary prevention of CVD, there are many limitations with respect to the reported studies. Most of the studies are single center, have small sample size, and have nonuniform methodologies, and only a limited number of RCTs have evaluated the impact of yoga on CVD. The majority of studies have short follow-up, and outcome studies are lacking. Multicenter, large studies using uniform methodologies with long-term outcomes are needed. However, even with the present evidence and considering that yoga is a simple, cost-effective technique with no side effects, yoga may be recommended alongside conventional medical care both for the prevention of CVD and for improving outcomes for those with existing CVD.

Summary and conclusions

CVD is the leading cause of death of people all over the world, and its incidence is increasing due, primarily, to unhealthy lifestyle. CVD appears to be a continuum of a chain of events initiated by risk factors such as dyslipidemia, hypertension, diabetes mellitus, smoking, and mental stress, which are known to promote oxidative stress, endothelial dysfunction, inflammatory responses, and vascular remodeling culminating into target pathology. Several studies have demonstrated that yoga may act on several levels of this CVD continuum and may be helpful in primary and secondary prevention of CVD. Yoga has been demonstrated to control several risk factors of CVD such as dyslipidemia, hypertension, diabetes mellitus, smoking, mental stress, and obesity. It may also reduce oxidative stress and inflammation and procoagulant status, and this may be useful in the primary prevention of CVD. Yoga has also been demonstrated to cause regression of atherosclerosis, decrease cardiac arrhythmias, and improve left ventricular function and may be useful in cardiac rehabilitation.

Author/study name	Type of study	Number in yoga group	Number control	Follow-up duration	Population	Findings
Raghuram et al., 2014	Randomized controlled study	129	121	12 months	Post CABG patients	HDL increase in yoga group ($p < .003$), VLDL decreased in the yoga group ($p = .03$) LDL and triglycerides not different i the two groups. However, LDL was significantly lower in the yoga group patients who had LDL > 10 mg/dL at the time of enrollment
Acharya et al., 2010	Longitudinal follow-up	20	–	–	Young footballers	HDL, LDL, VLDL, and triglycerides were all lowered after yoga
Shantakumari et al., 2013	Randomized	50	50	12 weeks	Diabetics	Total cholesterol, LDL and triglycerides were lowered and HDL leve increased in the yoga group. In the control group there was an increase in total cholesterol, LDL, HDL, and triglycerides
Mondal et al., 2014	Randomized controlled study	10	10	12 weeks	50–70 years	Total cholesterol, LDL, and triglycerides lower in the yoga group. Increased HD levels in the yoga group
Mandape et	Case control	50	50	5 years	Healthy adults (25–	Total

Table 13.1 Studies evaluating the impact of yoga on lipid profile

al., 2015	study				50 years)	cholesterol and triglycerides were significantly lower in the yoga group and HDL leve were higher i this group. LDL and triglycerides were not significantly different in th two groups
Pal et al., 2011	Randomized controlled study	85	85	6 months	Coronary artery disease	Total cholesterol, LDL, and triglycerides were lowered and HDL leve increased in the yoga group
Fields et al., 2002	Pilot trial	20	23	12 months	Elderly (age > 65)	Total cholesterol, LDL, and triglycerides were lowered and HDL cholesterol improved slightly in yoga group
Lee et al., 2012	Randomized controlled study	8	8	16 weeks	Postmenopausal	Total cholesterol, LDA, and triglycerides were lowered and HDL cholesterol improved in the yoga group
Mahajan et al., 1999	Randomized controlled study	52	41	14 weeks	Angina patients	Total cholesterol, LDL were lowered and HDL cholesterol improved in the yoga group
Cohen et al., 2008	Randomized controlled study	14	12	10 weeks	Metabolic syndrome	LDL cholesterol lowered and HDL cholesterol

						increased in the yoga group
Gordon et al., 2008	Randomized controlled study	62	62	6 months	Diabetes/metabolic syndrome	LDL and HDL were similar i yoga and exercise groups but VLDL was lower in the yoga group
Vaishali et al., 2012	Randomized controlled study	30	30	12 weeks	Diabetes/metabolic syndrome	LDL is lowere and HDL is improved in the yoga group
Jatuporn et al., 2003	Randomized controlled study	22	22	4 months	Coronary artery disease	HDL is slightl elevated with yoga and LDL total cholesterol and triglycerides were lower in the medical group compared wit yoga
Manchanda et al., 2000	Randomized controlled study	21	21	1 year	Coronary artery disease	Total, HDL cholesterol and triglycerides were decreased compared to controls. HDL cholesterol was not significantly changed
Yang et al., 2011	Randomized controlled study	13	12	3 months	Diabetes	Total, HDL, LDL and triglyceride levels were al decreased in the yoga group
Ornish et al., 1990	Randomized controlled	28	20	1 year	Coronary artery disease	Total and LDL cholesterol reduced significantly. I addition, regression of coronary stenosis was observed
Schmidt et al., 1997	Open trial	106		3 months	Healthy adults	Total and LDL cholesterol

						reduced significantly
Yogendra et al., 2004	Controlled open trial	71	42	1 year	Coronary artery disease	Reduction in serum total and LDL cholesterol. Regression of disease and arrest of progression was also note
Bijlani et al., 2005	Pretest–posttest	98		8 days	Heterogeneous group of patients with hypertension, coronary artery disease, diabetes mellitus, and a variety of other illnesses	Serum total, LDL, VLDL, th ratio of total t HDL cholesterol, and total triglycerides were significantly lower, and HDL cholesterol significantly higher
Vyas et al., 2008	Nonrandomized	49		6 months to 5 years	Postmenopausal normal women	Reduction in serum total and LDL cholesterol
Gupta et al., 2011	Pretest–posttest	123		2 years	Coronary artery disease	Significant decrease in LDL and triglycerides and increase in HDL. In addition, regression of coronary stenosis was observed in the most compliant group
Manchanda et al., 2013	Randomized control	50	50	1 year	Metabolic syndrome	Significant decrease in LDL and regression of early atheroscleros

CABG: coronary artery bypass graft; HDL: high-density lipoprotein; LDL: low-density lipoprotein; VLDL: very low-density lipoprotein.

Table 13.2 Studies evaluating the impact of yoga on smoking cessation					
Author/study name	**Type of study**	**Yoga group**	**Control group**	**Follow-up duration**	**Findings**
Sharma and Corbin, 2006	Randomized controlled study	21		6 months	Significant increase in mean self-control compared to control group
Elibero et al., 2011	Randomized controlled study	38	38	–	Exercise and yoga were both effective in decreasing the craving for smoking
Rawat et al., 2011	Randomized controlled study	10	10	6 weeks	Yoga and sudharshanakriya were more effective than yoga therapy alone for quitting smoking
Bock et al., 2012	Randomized controlled study	32	23	6 months	Yoga combined with cognitive behavioral therapy was more effective then wellness program and cognitive behavioral therapy
Shahab et al., 2013	Randomized controlled study	48	48	24 hours	Yogic breathing exercise significantly reduced craving compared to watching yoga video alone
McIver et al., 2004	Pretest–posttest	20		5 weeks	Transtheoretical model questionnaire was significantly higher than the pretest scores. One participant quit smoking
Kochupillai et al., 2005	Pretest–posttest	82		6 months	Sudarshanakriya and pranayama helped to control the tobacco habit. Urge to smoke was less

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Heart disease: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Dilip Sarkar finds that yoga therapy is useful for primary prevention and secondary prevention as well as rehabilitation of coronary artery disease (CAD). Beyond the physical benefits of the exercise involved, “yoga controls stress and anger, fosters psychological equanimity, increases a feeling of compassion for others and a sense of gratitude, and helps one stay calm in the middle of a crisis,” says Sarkar.

”From an ayurvedic perspective,” Sarkar says, “cardiovascular disease is basically a lifestyle disorder.” He links it with excess *pitta dosha* , which is consistent with the modern understanding of the role of inflammation in precipitating myocardial infarction. Pitta dosha is also linked with anger and hostility, emotional factors that have been implicated in CAD.

Carol Krucoff says, “Emotional imbalances are common among people with heart disease,” including anxiety and depression, stress, anger, hostility, impatience, and time urgency. Indeed, when Nischala Devi first started teaching yoga to patients in the Ornish Program for Reversing Heart Disease she instituted a rule: before beginning the program, all the students in the class had to take off their watches. Devi says, “Heart disease might be indicative of a certain personality type that needs to be in charge even when being the one in charge can cause further complication and disease process.” This again is entirely consistent with the pitta personality type as described in ayurveda. Devi adds, “Although this is a totally treatable disease with lifestyle modification, many people diagnosed with heart disease exhibit reluctance to change, especially when asked to adapt a healthy diet and manage their stress.”

”The first action with this population is to encourage them to fully relax and let go,” Devi says. Because practicing yoga is an unusual and unfamiliar practice to some people with CAD, she says, it “can initially increase agitation and mental and emotional discomfort, which is the polar opposite of what it is intended to do.” However, she continues, “after continuous repetition and explanation, the client may accept the concept of giving the practice a chance to prove its efficacy.” In her experience, she says, “When some of the positive effects are realized, like feeling calmer and lowering blood pressure, the enthusiasm steps up to support the practice.”

“Unless the client has recently had surgery,” Devi says, “a series of gentle poses is offered, with the emphasis on *gentle* . We are trying to reverse the behavioral patterns of overachieving and pushing beyond limits. The routine will consist of a few forward- and backward-bending poses and a gentle and assisted inversion,” modified to be easier and safer for heart patients than the versions typically taught in yoga classes. This gentle inversion (Fig. 13.3), Devi says, “can be easily accomplished by having the client lie on the floor, placing the feet and lower legs to the knee resting on a chair. With a pillow under buttock and head, this position elicits a relaxation response. If held with comfort for 3 minutes or longer, physical as well as mental emotional benefits can be observed." She cautions, "When coming out of inversion, have the client roll to the side for a minute to help normalize blood pressure before sitting up."

Sarkar says, "Yoga therapy for cardiovascular disease is primarily targeted to control the mind through deep internal awareness. This is achieved through relaxation of the physical body, effortless yogic breathing, and calming down the mind with prolonged *savasana* (corpse pose), pranayama, deep meditation, and mantra chanting." In working with students with CAD, he says, "we start with gentle relaxation of the physical body by sitting on a chair or in a cross-legged position on the ground, keeping the spine erect." The students are encouraged to place their hands in *jnana mudra* , palms facing up, touching the tips of their index fingers and thumbs. From there, they practice easy yoga breathing at a slow rate with the exhalation longer than the inhalation, and chant *om* during a long exhalation.

Figure 13.3
This modified shoulderstand is a gentle inversion and is mild enough for almost all patients with CAD.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Devi finds a slow, progressive deep relaxation in savasana position to be especially beneficial for people with CAD. She favors “a method that systematically goes over the physical and mental-emotional bodies [the *koshas,* see Glossary] several times from gross to subtle, including in the sequence a mental distancing and observation of the mind and emotions while moving consciously to the peace within.” The length of time varies, but she has found that “a minimum of 20 to 30 minutes has the greatest effect.” Afterwards, she encourages gentle three-part (sectional) breathing and, in students who are ready for it, alternate-nostril breathing while sitting, as a prelude to meditation.

Carol Krucoff often recommends meditation based on mindful awareness of the breath to patients with heart disease. “Mindfulness,” she says, “is an ancient practice that helps us learn to be present for our lives. One of the most basic mindfulness practices is observing the breath—without trying to change, control, or manipulate it.” To practice, she says, “Lie down or sit comfortably, or if necessary, you can practice while standing. Turn your attention to your breath, observing the movement of the air going into and out of your body. Without judging, labeling ‘good’ or ‘bad,’ or trying to change your breath in any way, notice the sensations associated with your breathing, including the temperature of the air flowing in and out and what parts of the body move. Is your breath deep and slow? Is it short and choppy? Just notice. If your thoughts wander off to the past or future or otherwise drift away from your breath, notice this ‘chattering mind’ without judgment, then bring your focus back to your breath again. You may need to do this over and over again—and that’s the practice.”

”The profound movement into silent meditation at the conclusion of the practice,” Devi says, gives “a much-needed time of introspection. It seems this population, especially, needs to see results and have it all make sense, before committing to a regular practice.”

Resources

Book: *The Healing Path of Yoga* by Nischala Joy Devi

Book: *Dr. Dean Ornish’s Program for Reversing Heart Disease* by Dean Ornish

CHAPTER FOURTEEN

YOGA THERAPY FOR HYPERTENSION

DL COHEN • M HAGINS

Introduction

Pathophysiology, etiology, and prevalence of hypertension

Hypertension is a major public health issue and affects approximately 70 million adults in the United States and more than a billion people worldwide (Edwards, DiPette, Townsend, & Cohen, 2014). For approximately 90% of people with hypertension, no specific underlying cause is identified and the hypertension is termed "essential" or "primary" in origin. The etiology of hypertension is multifactorial, with increased dietary intake of sodium, obesity, and inactivity serving as major contributors to essential hypertension. In addition, most people with essential hypertension have a positive family history of hypertension, although no specific genetic mutation has been clearly identified in essential hypertension.

Hypertension is classified according to severity and is divided into three stages, according to the *Seventh Report of the Joint National Commission on Hypertension* (Table 14.1 , p. 306) (Chobanian et al., 2003). There is a slightly different classification used in Europe (ESH/ESC Task Force for the Management of Arterial Hypertension, 2013). Prehypertension is defined in the United States as a blood pressure (BP) of 120–140 systolic or 80–90 diastolic mmHg. Individuals with prehypertension are at high risk for developing overt hypertension and are highly encouraged to incorporate lifestyle modifications as soon as the condition is detected. Stage 1 hypertension is defined as a BP of 140–160/90–100 mmHg. At this stage, drug therapy is often delayed and lifestyle modification is encouraged for a period of 6 months prior to starting drug therapy. Stage 2 hypertension is more severe hypertension and is defined as a BP of > 160/100 mmHg; these patients require initiation of drug therapy from the outset.

The initial treatment of prehypertension and stage 1 hypertension is to encourage lifestyle modification. For patients with stage 2 hypertension, who require drug therapy, lifestyle modification is also encouraged. This includes reducing dietary sodium intake, adoption of the DASH (Dietary Approach to Stop Hypertension) diet (diet high in potassium, fruits and vegetables, high fiber and low fat or nonfat dairy products), reducing weight to an optimal BMI of less than 25, reducing alcohol intake, and increasing physical activity (Chobanian et al., 2003). Lifestyle modifications are often difficult for patients to incorporate successfully, and many patients will go on to require drug therapy to treat their hypertension effectively.

Yoga has become increasingly popular in Western cultures, including the United States (Clarke, Black, Stussman, Barnes, & Nahin, 2015) and is an attractive alternative to medication in many patients with mild-to-moderate hypertension who prefer to avoid the use of medication (Bell et al., 2006; Sibbritt, Adams, & van der Riet, 2011; Thiyagarajan et al., 2015). The American Heart Association (AHA) has stated that health care providers may offer a trial of nonpharmacological interventions (including alternative modalities) as part of the initial treatment of stage 1 hypertension among patients wishing to avoid or delay drug therapy when clinically appropriate (Hudnut, 2014). The AHA did not recommend yoga due to lack of data from high-quality randomized controlled trials (RCTs); however, the AHA stated that most of the alternative approaches, such as yoga, pose few to no harmful side effects and may represent acceptable options for patients with multiple medication intolerances. Beyond the potential for musculoskeletal injuries, there are few cardiovascular health risks posed by yoga practice and no adverse events have been reported in the few completed trials. Consequently, for individuals with hypertension the practice of yoga may be an acceptable recommended lifestyle modification.

Scientific and psychophysiological rationale for the use of yoga for hypertension

Despite the increasing evidence that yoga may effectively reduce BP, models describing the mechanisms by which yoga accomplishes this outcome remain entirely speculative. First, it is necessary to recognize that yoga is a multimodal intervention that shares some practices known to reduce BP, namely, physical exercise and moderation of diet (diet is not necessarily an explicit part of yoga but commonly part of a yogic lifestyle and culture). The relative contribution of exercise and diet practices to reductions in BP from yoga remains unknown. However, the mechanisms by which these practices influence BP are well documented and consequently will not be addressed here.

The question remains, are there unique mechanisms by which yoga influences BP? A general consensus is forming around mechanistic models that focus on the concept of self-regulation (Gard, Noggle, Park, Vago, & Wilson, 2014; Innes & Vincent, 2007). Self-regulation, as well as its associated construct, emotion regulation, has been the topic of considerable theoretical and empirical research (Gross & Thompson, 2007; Hagger, 2010; Hofmann, Schmeichel, & Baddeley, 2012). Briefly, self-regulation refers to the individual's capacity to alter behaviors in accordance with some standards, ideals, or goals stemming from either internal or societal expectations (Baumeister, Masicampo, & Vohs, 2011). Existing models suggest that the primary pathway by which yoga uniquely influences BP is via reductions in stress response due to increases in self-regulation (Gard et al., 2014; Innes & Vincent, 2007).

The model in Figure 14.1 below uses features of previous models (Gard et al., 2014; Innes & Vincent, 2007) in a simplified diagram focusing on the single outcome of BP control. Essentially, as demonstrated in the right-hand side of Figure 14.1 , BP is the final result of autonomic and neurohormonal control of two factors: cardiac output and peripheral resistance. The precise causal links between yoga practices and autonomic and neurohormonal control remains unknown; however, there is foundational evidence suggesting plausible pathways, and the reader is encouraged to refer to Gard et al. (2014) and Innes & Vincent (2007) for more details.

Four practices are commonly considered essential to yoga: ethical precepts, meditation/mindfulness, physical postures, and breathing techniques. The model (Fig. 14.1) demonstrates that the four primary elements interact with each other within the practice of yoga. The degree to which the elements act independently versus synergistically remains unknown. BP varies with emotional state, which in turn varies with physical and psychosocial stressors. For example, perceptions of potential danger increase heart rate and peripheral resistance and therefore increase BP. In short-term situations, the adaptation of BP to stressful events is necessary. However, some individuals are in a chronic state of psychosocial stress, resulting in prolonged levels of hypertension that constitute genuine cardiovascular risk (Spruill, 2010).

As seen in Figure 14.1 , yoga may impact hypertension via improving self-regulation. "Top-down" self-regulation is thought to be a cognitive process involving higher level brain processing (attentional deployment, response inhibition, reappraisal), while "bottom-up" self-regulation is thought to be a physical body-related process using lower level brain processes associated with somatic, visceral, and sensory receptors. It is speculated by Gard et al. that the four elements of yoga assist in the integration of top-down and bottom-up processes to increase self-regulation (Gard et al., 2014). For example, top-down attention is focused on bottom-up sensation commonly in yoga, such as occurs when participants are encouraged to remain calm, alert, and aware of bodily sensation during challenging physical posture practice.

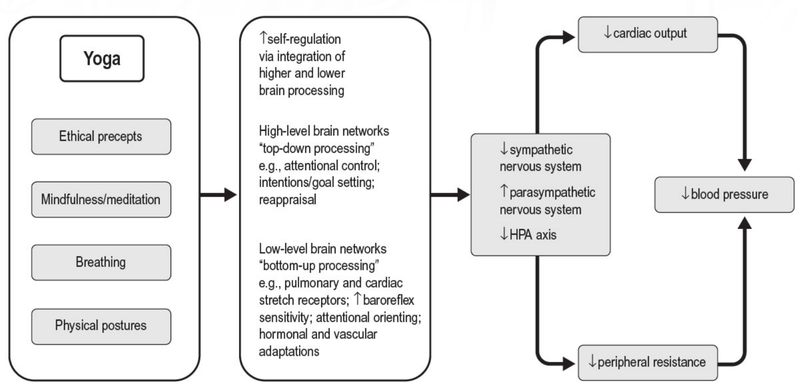

Figure 14.1
Speculative mechanistic model describing how yoga may influence blood pressure via increased self-regulation.
Adapted from models in Gard et al., 2014, and Innes & Vincent, 2007

In summary, the mechanisms underlying potential benefits of yoga to BP control remain unknown and are purely speculative at this time. Physical practices of yoga and modifications of diet due to the yogic lifestyle may influence BP through well-accepted pathways. The primary framework currently described by those researching yoga is that of self-regulation. This theory suggests that yoga increases self-regulation through integration of top-down and bottom-up brain processing, and one outcome of this is improved BP control.

Review and analysis of select randomized controlled clinical trials on yoga and hypertension

There have been an increasing number of publications in the literature addressing the effects of yoga on BP reduction. Many of these studies have been of poor quality, have had fewer than 30 participants, have not been randomized, and have had significant methodological limitations. Most of the early studies included fewer than 20 participants in a group and were mostly performed in India and Thailand. There are now at least 16 RCTs of any form of yoga for hypertension. We have included a narrative review of the studies that are of a higher quality and that have included at least 30 participants, have used yoga as a primary therapy as opposed to breathing or biofeedback techniques, and in whom participants have hypertension as an inclusion criteria. These studies are shown in Table 14.2 (p. 307). It is important to point out that the quality of these types of studies has improved considerably in recent years, with the majority of the studies with higher quality data published in the last 4–5 years.

The first study, from England, was published in 1975 (Patel, 1975). This was a crossover RCT that included 34 adults with hypertension who were randomly assigned to yogic relaxation with biofeedback or placebo with general relaxation for 60-minute sessions twice a week for a period of 6 weeks. After a 2-month washout period, the groups were crossed over and the placebo group was then randomized to yoga and biofeedback and vice versa. There was a significant reduction in BP in subjects in the yoga group, with mean BP reduction of 27/16 mmHg versus 9/5 mmHg in the treatment versus placebo group comparison. The major criticisms of this study are that there was no active control group and this was a small study. Despite these issues, this was an important study because it was the first RCT assessing the effects of yoga on BP reduction, and it raised awareness of this field of study.

The next study to be published was in 1990, which randomized 35 subjects for 12 months to hatha yoga and autogenic training for 15 minutes twice daily versus relaxation for 15 minutes twice per day. There were no significant changes in SBP or DBP at 1 year in either group. This was a small study with fewer than 20 participants in either group, and it is difficult to know what the level of compliance was with the extended intervention period of 1 year (van Montfrans, Karemaker, Wieling, & Dunning, 1990). In 2000, Murugesan et al. published a small study from India of 33 hypertensive adults who were randomly assigned to three groups (yoga, medications only, or no therapy) and were followed for 11 weeks (Murugesan, Govindarajulu, & Bera, 2000). Yoga was performed at home for 6 hours per week and included a combination of asanas, pranayamas, and mantras. At the end of the study, SBP was reduced by an impressive 33 mmHg compared to 4 mmHg in the control group and 24 mmHg in the drug therapy group. The differences were significant compared to both control and drug treatment. This was again a small study with poorly described interventions. Changes in BP with yoga were also very large and much more than one would expect even with drug therapy. In 2005, McCaffrey published an 8-week pranayama and asana yoga program conducted in 54 untreated hypertensive patients living in Thailand (McCaffrey, Ruknui, Hatthakit, & Kasetsomboon, 2005). Twenty-seven subjects were randomized to hatha yoga and relaxation for 60-minute sessions 3 times a week for 8 weeks, and 27 subjects were randomized to a control continuing with usual care. The experimental group significantly reduced SBP by 25 mmHg at 8 weeks compared to 2 mmHg increase in the control group. DBP significantly decreased by 18 mmHg in the experimental group compared to an increase of 2 mmHg in the control group. This again was a very small study with very impressive BP reductions in the group assigned to yoga. The control group was not well described.

In 2009, Saptharishi et al. published a study in India (Saptharishi et al., 2009). This was an RCT with four crossover groups and included 113 young adults with prehypertension. A total of 113 subjects were assigned to groups of 30, 28, 28, and 27 and participated for 8 weeks in either a (1) control group with no intervention, (2) physical exercise, (3) brisk walking for 50–60 minutes, 4 days per week, and reduced dietary sodium intake, or (4) a yoga practice group for 30–45 minutes per day on at least 5 days per week. A total of 102 participants (29, 27, 25, and 21 in groups I, II, III, and IV) completed the study. All three intervention groups showed a significant reduction in BP (SBP/DBP: 5.3/6.0 in group II, 2.6/3.7 in III, and 2.0/2.6 mmHg in IV respectively). There was no significant change (SBP/DBP: 0.2/0.5 mmHg) of BP in the control group. Physical exercise was the most effective of all the groups in BP reduction. There was a follow-up study published in 2011 by the same group in India. Subjects were adults with prehypertension who were randomly allotted to a group that they had not been randomized to in the previous trial (Subramanian et al., 2011). They were assigned to one of four groups for 8 weeks: control group, brisk walking 50–60 minutes 3–4 days a week, sodium restriction to at least half of their previous intake, or yoga for 30–45 minutes per day, 5 days per week. Ninety-four participants (25, 23, 21, 25) completed the study. All three intervention groups but not the control group showed significant reduction in BP, but the physical exercise group showed a greater reduction on BP, in the range of 5/6 mmHg, whereas sodium reduction and yoga showed a less impressive decline in BP in the range of 2.5/2.0 mmHg (Subramanian et al., 2011). There was persistence of significant reduction in BP in all three intervention groups after crossover; however, physical exercise was the most effective.

In 2010, a study by Cade et al. was published in the United States of 60 HIV-infected adults with moderate cardiovascular disease (CVD) and with 83% of subjects diagnosed with hypertension (Cade et al., 2010). Subjects were assigned to supervised ashtanga yoga for 60 minutes 2–3 times per week for 20 weeks versus standard of care treatment. Resting SBP and DBP improved more in the yoga group (5/3 mmHg) than in the standard of care group (+1/+2 mmHg).

A study was published by Cohen et al. in 2011 in the United States in which subjects with prehypertension to stage 1 hypertension were randomized to a structured Iyengar Yoga (IY) program or enhanced lifestyle modification (LSM) (D. L. Cohen et al., 2011). In total, 26 and 31 subjects in the IY and LSM arms, respectively, completed the study. There were no differences in BP between the groups at 6 and 12 weeks. In the LSM group, 24-hour SBP, DBP and mean arterial pressure (MAP) significantly decreased by 5, 3, and 3 mmHg, respectively, from baseline at 6 weeks ($p < .05$), but were no longer significant at 12 weeks. In the IY group, 24-hour SBP was reduced by 6 mmHg at 12 weeks compared to baseline ($p = .05$). 24-hour DBP ($p < .01$) and MAP ($p < .05$) decreased significantly each by 5 mmHg. This study showed clinically meaningful reductions in 24-hour ambulatory BP readings in the IY group at 12 weeks. This study also used ambulatory BP monitoring to measure BP, which is more accurate than clinic or office BP readings.

A 2013 study by Pal et al. in India included 258 subjects with coronary artery disease (Pal, Srivastava, Narain, Agrawal, & Rani, 2013). Subjects were randomized to medication and 35–40 minutes per day of yoga 5 days per week for 18 months or medication alone. Two hundred and eight subjects completed the study. A statistically significant decrease in SBP of 7.0 mmHg and DBP of 3.2 mmHg was observed in the yoga group. In the control group, SBP was decreased by 0.7 mmHg and DBP increased by 1.5 mmHg.

A study by Wolff et al. (2013) in Sweden enrolled 83 subjects with various levels of BP ranging from prehypertension to stage 2 hypertension (Wolff, Sundquist, Larsson Lonn, & Midlov, 2013). Subjects were matched and allocated for 12 weeks to yoga classes with an instructor versus yoga practice at home versus a control group of usual care. Most subjects (92%) were on medication and subjects were instructed not to make any medication changes during the study. The yoga class group showed no improvement in BP whereas the yoga-at-home group showed a decline in diastolic BP of 4.4 mmHg ($p < .05$) compared to the control group. These are many limitations of this study in that subjects were not randomized: they were matched for SBP but not for the amount of medications they were taking, there were more women in the yoga group at home, and women appeared to have the greatest decrease in SBP in response to yoga compared to men. The differences in age and gender between the groups were, however, not significant.

A recent study by Hagins et al. (2014) in the United States randomized 84 adults with prehypertension or stage I hypertension to either 12 weeks of ashtanga yoga for 55 minutes twice a week or nonaerobic exercise for 55 minutes twice a week (Hagins, Rundle, Consedine, & Khalsa, 2014). Sixty-eight subjects completed the study. Ambulatory BP monitoring was performed in all subjects at baseline at 12 weeks. There was a significant reduction in DBP, nocturnal DBP, and MAP (−4, −5, −4 mmHg, respectively) in the yoga group but no significant within-group changes in the active control group. Direct comparisons of the yoga intervention with the control group found only nocturnal DBP to be significantly different, favoring the yoga intervention ($p = .038$).This study was probably not adequately powered to show between-group differences.

Another recent study from India randomized adults with prehypertension aged 20–60 years without known CVD to either a LSM (lifestyle modification) group or a LSM and yoga group for 12 weeks (Thiyagarajan et al., 2015). The intervention consisted of yoga classes in a center for 45 minutes 3 times per week. An attendance register was maintained, and those who had at least 80% of attendance at the end of 12 weeks of the yoga intervention were considered to have completed the study. Forty-nine subjects completed the study in the LSM group and 51 subjects completed the study in the combined LSM/yoga group. There was a significant reduction of 4/3 mmHg and 6/4 mmHg in the LSM group versus the LSM/yoga group, respectively. The reduction in SBP was significantly more in the LSM/yoga group (6 mmHg) compared to the LSM group (4 mmHg) (p = .04). The DBP was not significantly different between groups. There was, however, a large (48%) dropout rate in this study.

A recent follow-up study by the group from Philadelphia (Cohen, Bower, & Townsend, 2014) randomized 137 subjects with untreated prehypertension and stage 1 hypertension to one of three treatment groups for 24 weeks: hatha yoga for 90 minutes 2–3 times per week in a yoga studio versus a supervised diet/weight-reduction and walking program versus a combination program of both yoga and dietary intervention. Subjects had inpatient 24-hour ambulatory BP monitoring performed at baseline, 12, and 24 weeks. Ninety subjects completed the protocol. SBP and DBP were significantly reduced within all three groups at 3 and 6 months. BP changes were reduced by 3/3 and 3/3 mmHg in the yoga group at 3 and 6 months, by 1.6/1.8 and 3.6/2.3 mmHg in the diet group, and by 3/2 and 3/2.5 mmHg in the combination group. Between-group changes in SBP between yoga and diet from baseline to 12 weeks were (Δ 1.4 mmHg, p = .0073) and between diet and combo (Δ 1.56 mmHg, p = .0021) favoring the yoga and combination groups over diet alone at 3 months. Differences were no longer significant at 6 months. There was no difference between the yoga and combination groups at any time period. There was a higher than expected dropout rate of 34%.

Review and description of systematic reviews and meta-analyses of studies on yoga and hypertension

A recent AHA review (Hudnut, 2014) stated, “As far as we are aware, no formal meta-analysis of the effects of yoga on BP has been performed.” Within the following 18 months, three systematic review/meta-analyses (Cramer et al., 2014a; Cramer et al., 2014b; Hagins, States, Selfe, & Innes, 2013), of the effects of yoga on BP were published. In addition, in the same time period, three systematic reviews on the same topic were published (Posadzki, Cramer, Kuzdzal, Lee, & Ernst, 2014; Tyagi & Cohen, 2014; Wang, Xiong, & Liu, 2013). Details of these publications are shown in Table 14.3 (p. 309). This rapid increase in the number of papers attempting to summarize the evidence on the effects of yoga on BP likely represents both the increasing number of available studies on this topic and the increasing acceptance of yoga as a viable form of alternative medicine.

Each of the recent reviews of the effects of yoga on hypertension used slightly different criteria for acceptable study design, intervention, subjects, and databases searched. Four of the reviews (Cramer, et al., 2014a; Cramer, et al., 2014b; Posadzki et al., 2014; Wang et al., 2013) only examined RCTs, while one (Hagins et al., 2013) examined both RCTs and controlled trials and one (Tyagi & Cohen, 2014) examined RCTs, non-RCTs, cohort, and case studies. The number of databases searched varied from three (Wang et al., 2013) to 17 (Posadzki et al., 2014).

A common dilemma within the entire field of yoga research is the variability of yoga practice and the lack of study intervention standardization. Consequently, when researchers decide to review the effects of yoga interventions they must make operational decisions regarding what should and should not represent yoga practice relative to their review criteria. These distinctions are difficult to make and often involve verbal descriptions that require some form of interpretation. For example, Posadzki and colleagues (Posadzki et al., 2014) included studies of yoga that were “based on traditional yoga philosophy or practice and that can consist of one of more of the following: specific postures, breathing exercises, body cleansing, mindfulness meditation and lifestyle modifications”; while

Hagins and colleagues (Hagins et al., 2013) used as criteria "… papers that explicitly labeled the intervention as yoga … excluding meditation only, mindfulness based stress reduction, transcendental meditation, relaxation response … and practices historically related to yoga such as bloodletting, starvation, and cleansing of the stomach." Tyagi et al. (Tyagi & Cohen, 2014) included studies with any specific component of yoga or any "yoga type" intervention and Cramer et al. (Cramer, et al., 2014a) simply said "any type of yoga intervention greater than 8 weeks." Relative to patient selection, all reviews included papers whose subjects had hypertension. One study (Cramer, Lauche, et al., 2014) focused on the more general issue of cardiovascular conditions but reported findings relative to hypertension alone.

Despite these differences in approach, the six reviews all report a similar primary finding, namely, that yoga has demonstrated preliminary evidence that it can reduce BP by clinically significant amounts. All reviews agreed that the existing evidence generally had high levels of potential bias and that additional larger and more rigorous studies need to be performed. No reviews reported any harm from yoga. Despite large differences in study methods, the three available meta-analyses found relatively similar findings, with systolic pressures being reduced by 4.17, 9.65, and 5.85 mmHg and diastolic pressures being reduced by 3.26, 7.22 and 4.12 mmHg (Cramer, et al., 2014a; Cramer, et al., 2014b; Hagins et al., 2013), respectively.

Summary and conclusions

There is growing interest in the area of yoga research and particularly in the field of hypertension. There has recently been an increase in both the quantity and quality of the research being published in mainstream journals. A general critique of the older published yoga and hypertension research was that most studies were not randomized, had inadequately described yoga or control programs, did not collect information on other lifestyle confounders (e.g., adoption of vegetarian diet, reduction in alcohol intake) and did not use standardized, reliable outcomes measures. There is also a very real possibility of publication bias in which yoga trials with negative results have not been published. Some of the older studies also report much more impressive reductions in BP than one would expect with a lifestyle intervention, and this does call into question the validity of the data. Many of the studies reporting larger changes in blood pressure were performed with a sphygmomanometer as compared to the currently recommended continuous noninvasive BP monitoring, which is more accurate. Most lifestyle interventions, including regular aerobic exercise, dietary sodium reduction, and weight loss of 10 kg usually result in a BP reduction in the range of 4–10 mmHg in SBP. The latest research, especially in the last 2–3 years, has greatly improved on these prior issues. There still remain issues with large dropout rates in these lifestyle studies and many of the studies are underpowered. That being said there does appear to be a valid but small reduction in BP with the use of yoga alone or combined with other lifestyle modifications. The exact mechanisms by which yoga can potentially lower BP have still not been fully elucidated, and this remains a necessary area of research.

Although the effects of yoga on lowering BP are likely modest in most patients, the Framingham Heart Study showed that a 2 mmHg reduction in DBP can reduce the risk of stroke or transient ischemic attack by 14% (Lewington, Clarke, Qizilbash, Peto, & Collins, 2002; Whelton et al., 2002), and a 10 mmHg reduction in SBP, seen with prescription drugs and in some meditation studies, is associated with a 30% relative reduction in risk of stroke. Thus smaller reductions in BP (5 mmHg in SBP or 2 mmHg in DBP), achievable through diet, and yoga can be expected to significantly reduce CVD morbidity, particularly at the population level. There are few side effects of yoga aside from risk of minor musculoskeletal injuries, and therefore based on the available data we feel it is reasonable to encourage the use of yoga as an alternative to medication in mild hypertension and as an adjunct to medication therapy in patients with more severe hypertension.

Table 14.1 Classification of hypertension			
Classification of blood pressure			
Category	SBP mmHg		DBP mmHg
Normal	< 120	and	< 80
Prehypertension	120–139	or	80–89
Stage 1 hypertension	140–159	or	90–99
Stage 2 hypertension	≥ 160	or	≥ 100

SBP: systolic blood pressure; DBP: diastolic blood pressure.
Adapted from JNC VII guidelines for high blood pressure (Chobanian et al., 2003).

Table 14.2 Selection of randomized controlled trials of yoga and hypertension

First author, year, country	Number and characteristics of subjects	Experimental intervention/concomitant drug therapy	Control intervention	BP differences between groups
Patel, 1975, England (Patel, 1975)	34 adults with hypertension	Yogic relaxation/breathing/meditation and biofeedback/ 60-min sessions/2 × week for 6 weeks	No treatment	Significant fo SBP (*p* < .005) and DBP (*p* < .001)
Van Montfrans, 1990, Netherlands (van Montfrans et al., 1990)	35 adults with hypertension	Hatha yoga + autogenic training/ 15 min twice daily for 12 months	Relaxation 2 times per day for 15 min	No significan change for SBP and DBP
Murugesan, 2000, India (Murugesan et al., 2000)	33 adults with hypertension	Hatha yoga + meditation/ 63-min sessions 2 × day 6 days/wk 11 weeks	1. Medication (antihypertensives) 2. No treatment	Significant fo SBP (*p* < .01 and nonsignifican for DBP
McCaffrey, 2005, Thailand, (McCaffrey et al., 2005)	53 adults with hypertension	Hatha yoga + relaxation/63-min sessions 3 × a week for 8 weeks	Usual care	Significant fo SBP (*p* < .01 and DBP (*p* < .01)
Saptharishi, 2009, India (Saptharishi et al., 2009)	113 young adults with prehypertension	Hatha yoga 30–45 min/day 5 days/week for 8 weeks	1. Exercise 50–60 min 4 days/week 2. Diet changes 3. No treatment	No significan change for SBP and DBP
Cade, 2010, USA, (Cade et al., 2010)	60 HIV-infected adults with prehypertension and hypertension	Ashtanga yoga 60-min sessions 2–3/week for 20 weeks	Usual care	Significant fo SBP (*p* = .04 and DBP (*p* = .04)
Subramanian, 2011, India, (Subramanian et al., 2011)	98 young adults with prehypertension	Hatha yoga 30–45 min/day 5 days/week for 8 weeks	1) Exercise 50–60 min 4 days/week 2) Diet changes 3) No treatment	No significan change for SBP and DBP
Cohen, 2011, USA, (D. L. Cohen et al., 2011)	78 adults with prehypertension and stage I hypertension	Iyengar yoga/70 min for 12 weeks for 18 sessions	Enhanced usual care	No significan change for SBP and DBP
Pal, 2013, India, (Pal et al., 2013)	258 adults with coronary artery disease	Yoga 35–40 min sessions 5 × /week for 18 months	Usual care	Significant fo SBP (*p* = .002) and DBP (*p* = .0002)
Wolff, 2013, Sweden (Wolff et al., 2013)	83 adults with prehypertension, stage 1 and stage 2 hypertension	Yoga classes for 60 min once a week and home practice/yoga at home for 15 min daily for 12 weeks	Usual care	Nonsignifican decrease for SBP; significant decrease in DBP in yoga

				at home group ($p <$ .05)
Hagins , 2014, USA, (Hagins et al., 2014)	84 adults with prehypertension or stage I hypertension	Ashtanga yoga 55 min sessions 2 × /week for 12 weeks	Nonaerobic exercise 55 min sessions 2 ×/ week for 12 weeks	Nonsignificar for SBP; significant fo night-time DBP ($p =$ .038); nonsignificar for 24 h DBP
Thiyagarajan, 2015, India, (Thiyagarajan et al., 2015)	192 prehypertensive adults with known CVD	Lifestyle modification and yoga 45 mins 3 × /week for 12 weeks	Lifestyle modification	Significant decrease in SBP $p <$ .05, nonsignificar for DBP
Cohen LIMBS Study, 2014, USA	137 adults with prehypertension or stage I hypertension	Hatha yoga 90 minutes 2–3 times/week for 24 weeks vs. combination of yoga and diet	Diet and walking 10,000 steps/day 6 days/week	Significant decrease in SBP at 3 months only

CVD: cardiovascular disease; DBP: diastolic blood pressure; h: hours; min: minutes; SBP: systolic blood pressure.

Table 14.3 Systematic reviews/meta-analyses of yoga and blood pressure			
First author, year	**Type of study**	**Search strategy and inclusion criteria**	**Findings**
Posadzki, 2014 (Posadzki et al., 2014)	Systematic review	•Databases: 17 databases from inception to 2014 •Studies examined: *only* RCTs included; any type of control group; excluded trials on mindfulness meditation or MBSR •Hypertension: any form of arterial hypertension (pre- or hyper-) with or without comorbidities •Yoga: "a practice that was based on traditional yoga philosophy or yoga practice and that 'can consist of one or more of the following: specific postures, breathing exercises, body cleansing, mindfulness meditation, and lifestyle modifications' were considered as yoga …"	•# of studies included: 17 •11 studies reduced systolic •8 studies reduced diastolic •"Evidence … encouraging but inconclusive … more rigorous trials warranted"
Cramer, 2014 (Cramer, et al., 2014a)	Systematic review and meta-analysis	•Databases: 4 databases from inception to 2014 •Studies examined: RCTs, cluster randomized trials; yoga compared to active control or usual care only •Hypertension: any form of arterial hypertension (pre- or hyper-) with or without comorbidities; •Yoga: "any form of yoga ≥ 8 weeks"	•# of studies included: 7 •6 RCTs comparing yoga to usual care found mean reduction of −9.65 systolic and −7.22 diastolic •*No* evidence for effects of yoga compared to exercise
Cramer, 2014 (Cramer, et al., 2014b)	Systematic review and meta-analysis	•Databases: 4 databases from inception to 2013 •Studies examined: RCTs, randomized crossover studies; yoga compared to active control, usual care, or no treatment •Hypertension: participants–healthy; nondiabetic with high risk for CV disease, including patients with pre- and hypertension and type 2 diabetes •Yoga: not defined in text. Excluded if yoga part of "multi-modal" intervention. "Studies examining meditation or yogic lifestyle without physical component were also excluded"	•Of the 44 studies included only 8 examined individuals with hypertension •8 studies (various comparison groups, various types hypertension) found mean reduction of −10.00 systolic and −7.45 diastolic
Tyagi, 2014 (Tyagi & Cohen, 2014)	Systematic review	•Databases: 7 databases (dates unclear) plus Yoga Mimamsa and *International Journal of Yoga* •Studies examined: all types: RCTs, NRCTs, cohort, case studies •Hypertension: "all studies that examined BP as a primary or secondary outcome" •Yoga: included if "any specific component of yoga as well as all studies with a yoga type intervention such as slow, relaxed, focused breathing or yogic meditation such as bhrama kumara, ananda marg, raja yoga, om meditation, mantra meditation, sahaj	•Of the 120 studies included 48 were RCTs—and of those, 25 were of integrated yoga practice and 3 on relaxation, 6 on slow

		yoga meditation, Sudarshan Kriya Yoga, kundalini yoga". Also included were studies on "biofeedback" and use of the resperate device. Excluded: mindfulness meditation, transcendental meditation, zen meditation.	breathing, and 8 on resperate device •Most studies report decreased BP
Wang, 2013 (Wang et al., 2013)	Systematic review	•Databases: 3 databases from various start points through 2013 •Studies examined: only RCTs; yoga compared to no treatment or conventional therapy •Hypertension: only listed search words: hypertension, essential hypertension •Yoga: only listed search words: "yoga"	•# of studies included: 6 •"Encouraging evidence of yoga for lowering SBP and DBP" •Poor methodological quality
Hagins, 2013 (Hagins et al., 2013)	Systematic review and meta-analysis	•Databases: 10 databases from 1966 through 2013 •Studies examined: RCTs and NRCTs; yoga compared to usual care, waitlist, active control, exercise •Hypertension: pre- or hypertension only •Yoga: "… papers that explicitly labeled the intervention as yoga … excluding meditation only, MBSR, relaxation response, transcendental meditation, single yoga session studies	•# of studies included: 17 studies (22 trials)—9 RCTs, 8 controlled trials •Mean 4.17 and 3.26 decrease in SBP and DBP respectively

BP: blood pressure; DBP: diastolic blood pressure; MBSR: mindfulness-based stress reduction; min: minutes; NRCT: nonrandomized controlled trial; RCT: randomized controlled trial/randomized clinical trial; SBP: systolic blood pressure.

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Hypertension: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

“The approach to patients with hypertension,” says Timothy McCall, depends in part on how high the BP is. “If it’s poorly controlled, say 180/110 mmHg, or if there are signs of end-organ damage like retinal changes or left ventricular hypertropy, it’s advisable to hold off on any strenuous practices, any breath-holding, and most inversions, sticking with gentle breath-based movements, relaxation, and simple breathing exercises until the numbers can be lowered. Most physicians advise that once the pressure is well controlled, there are no limits on exercise, including yoga, but many yoga therapists are more conservative.”

”What we do,” McCall says, “is carefully scrutinize the students as they practice. If they seem jittery or become so while doing asana, particularly invigorating poses like handstands or strong backbends, it’s often signaling that those poses are too stimulating to their already-dominant sympathetic nervous systems. In such cases, I advise omitting or modifying the offending poses so that they can be done with ease and equanimity. The same may be true for some strong pranayama practices, like a rapid and deep *bhastrika* (bellows breath).”

Carol Krucoff says, “Breathing techniques, meditation, and relaxation all can be extremely useful in dealing with emotional and physical imbalances common to people with hypertension.” In particular, she recommends mindful awareness of the breath, relaxed abdominal breathing, three-part breath (sectional breathing) and what she calls “even breath” (*samavritta pranayama*), and extended exhalation breathing. McCall says, “All of these practices, particularly extended exhalation, tend to increase parasympathetic tone.”

To begin extended exhalation breathing, Krucoff says, “Lie down or sit tall and turn your attention to your breath. Once you’ve settled in, mentally count the length of your inhalation and the length of your exhalation. Without forcing or straining, try to make your inhalation and exhalation equal in length.” Then begin to “play with making your exhalation longer than your inhalation. For example, if you inhale to the count of 4, try exhaling to the count of 5 or 6. Once this is easy, try to make your exhalation up to twice as long as your inhalation: if you’re inhaling to the count of 3, try to exhale to the count of 6. As with all yoga practice, don’t strain. Longer isn’t necessarily better. Just play with finding a ratio that’s comfortable and relaxing for you.”

Ananda Balayogi Bhavanani finds that many patients with hypertension show “a lack of patience to even wait their turn in the clinic. Often there is a strong refusal to accept advice and a tendency to blame someone else for their having hypertension.” Such people, he finds are often “high-strung, *vata dosha* predominant with suppressed and repressed emotions. Over a period of time, they slowly settle down and start to see the cause of their problems, maybe more often than not, is within themselves. This is a special ‘healing moment,’ and often when this happens we find that they can change the course of their condition as they become more open to the yogic concepts of positive attitudes and lifestyle modifications.”

Krucoff says, “Teaching people to connect with their breath and to recognize that the breath can be a useful tool in connecting with their emotional state.” For example, “Fast, restricted, and/or shallow breathing is common under stress. Learning to recognize when this happens and mindfully relax the breath can be very therapeutic.” Bhavanani emphasizes “practices that enhance mind–body harmony through the use of breath-linked movements.” For example, he says, *surya namaskar* (sun salutations) can be done slowly with breath awareness. The postures, as he teaches them, “are held without strain for a short period with meditative awareness of the *surya mantras* (names of the sun).”

Figure 14.2

Supported bridge pose on a single folded blanket is a mild inversion that may stimulate baroreceptors.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

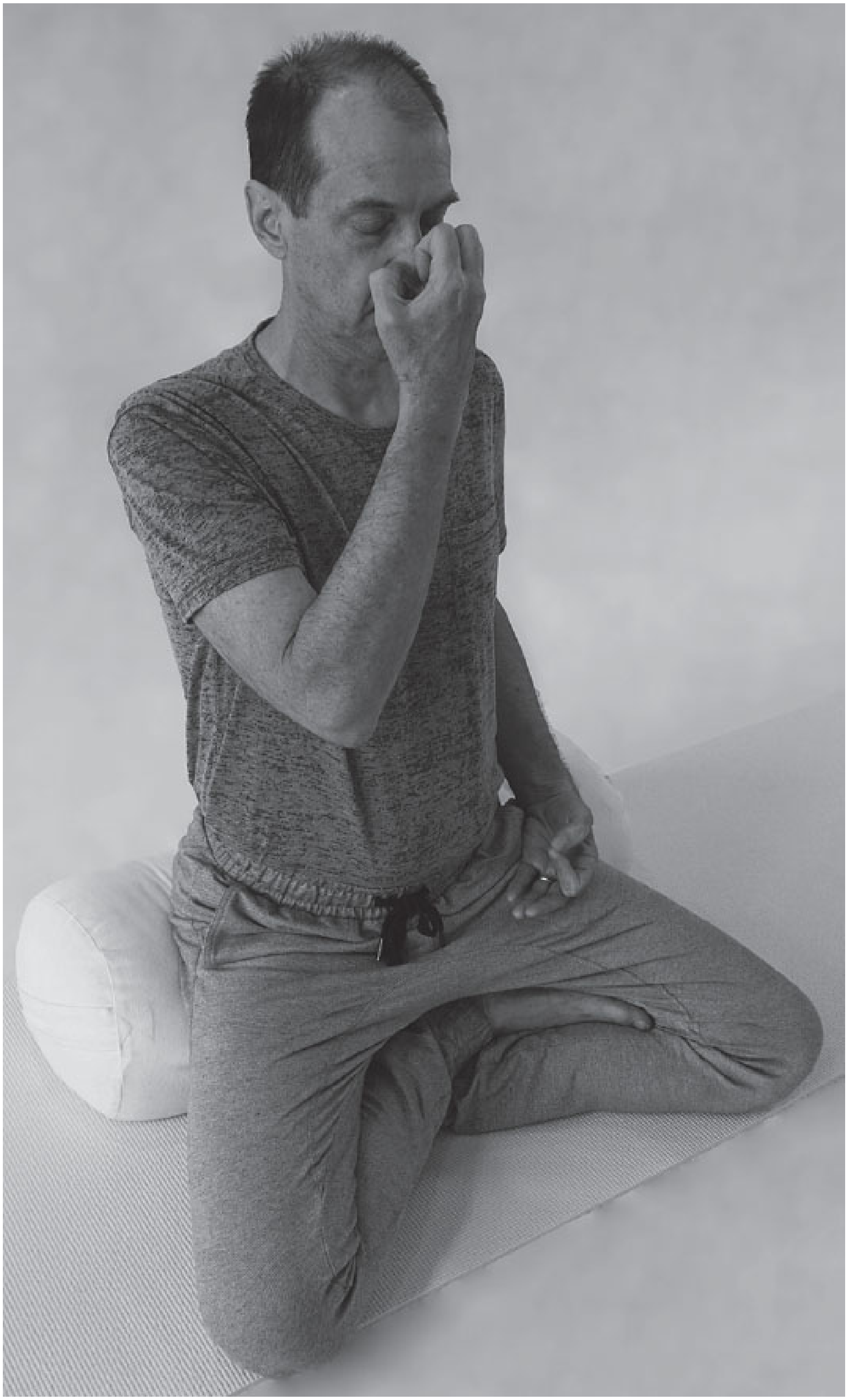

Figure 14.3
Nadi shodhana can be done using the fingers to block one nostril at a time, as shown, or by simply imagining the air flowing through one nostril, then the other.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

McCall says that although inversions are not appropriate for students whose hypertension is not well controlled, if it less than, say, 140/90 mmHg, inverted postures may be beneficial. Bhavanani says, “Topsy-turvy poses may help in resetting baroreceptor reflex mechanisms that regulate blood pressure.” If the student can’t do inversions like *sarvangasana* (shoulderstand) and *setu bandha* (bridge pose), other poses in which the head is below the heart, such as *uttanasana* and downward-facing dog, may have a similar effect. “Another option,” says McCall, “and among the mildest inversions in the yoga therapy toolbox, is the restorative version of bridge pose, in which the student lies on top of a folded blanket with the tops of the shoulders just touching the floor” (Fig. 14.2).

Bhavanani has found a number of pranayama techniques to be useful, including those that focus on the left nostril, “that help reduce sympathetic overactivity,” as well as *bhramari* (bee breath) and the cooling pranyamas *shitali* and *sitkari* . He has also had good results with a number of hatha yoga relaxation practices done in *savasana* (corpse pose), including *spandha nishpandha kriya* (alternate tension and relaxation), *marmanasthanam kriya* (part-by-part relaxation), and *yoga nidra* .

McCall says that alternate-nostril breathing, or *nadi shodhana* , is an effective way to balance the sympathetic and parasympathetic branches of the autonomic nervous system. Normally, this practice is done using the fingers to block either side of the nose, something some yoga therapy patients find cumbersome or, due to concomitant health conditions like arthritis, impossible. “One alternative,” he says, “is mental nadi shodhana, which can be done either seated or supine. Simply imagine the air flowing in through your left nostril, then out through your right nostril, then in through your right nostril and out through the left. Continue this pattern for 1 to 5 minutes, ending with an exhalation through the left nostril before returning to normal breathing.” Many people find this practice so calming, he says, “that they naturally find themselves resting in meditation for a few minutes afterwards” (Fig. 14.3).

McCall adds, “The most amazing thing to me is that almost everyone I’ve taught mental nadi shodhana to confirms that when they imagine the breath flowing through a particular nostril, it does. In yoga, it’s said that *prana* follows the *chitta* —the breath follows awareness. This is a perfect illustration of that principle.”

Resources

Book: *Yoga Chikitsa: The Application of Yoga as a Therapy* by Ananda Balayogi Bhavanani

Webinar: Yoga for High Blood Pressure by Timothy McCall, www.YogaUOnline.com

CHAPTER FIFTEEN

YOGA THERAPY FOR RESPIRATORY CONDITIONS

L BERNARDI • NF BERNARDI • G PASSALACQUA

Introduction

Definitions

Chronic obstructive pulmonary disease (COPD) is a chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. This definition was previously used to also incorporate terms such as chronic bronchitis, emphysema, and asthma because these conditions can overlap in the same patient or evolve from one to another. However, currently, asthma is usually considered as a separate entity, on a clinical and functional basis. Asthma is defined as recurrent attacks of breathlessness and wheezing, varying in severity and frequency and usually reversible. COPD and asthma are the two major lung diseases and are the only ones that have been researched with yoga therapy.

Epidemiology

Respiratory disorders are continuously increasing in prevalence worldwide. The causes are complex, but smoking and pollution clearly are dominant risk factors, at least for COPD. Moderate to severe COPD affects 65 million people (World Health Organization estimates). More than 3 million people died of COPD in 2005 (5% of all deaths globally). In the past decades, COPD was more common in men. Currently, the disease affects men and women almost equally, due to increased tobacco use among women in high-income countries and indoor air pollution in low-income countries. COPD was the fifth leading cause of death in 2002 and is estimated to become the third leading cause of death worldwide in 2030.

As of 2007, about 34.1 million Americans (9 million children) had been diagnosed with asthma. This number is increasing, especially among children under the age of 6 years, and the disease is becoming more severe. Asthma is estimated to cause 3,500–5,000 deaths annually in the United States. In 2007, it was responsible for 217,000 emergency room visits and 10.4 million office visits, with an estimated cost of $19.7 billion. Worldwide, asthma affects about 300 million people.

Pathophysiology

Chronic obstructive pulmonary disease

COPD is characterized by chronic inflammation of the airways, lung tissue, and pulmonary blood vessels as a result of chronic exposure to inhaled irritants such as tobacco smoke (Tuder & Petrache, 2012). Protease–antiprotease imbalance, oxidative stress, inflammation, apoptosis, and extracellular matrix remodeling are believed to play a major role in COPD. The sustained inflammatory process leads to progressive tissue damage and remodeling, accompanied by numerous systemic effects, which further perpetuate airflow limitation and physical inability. In addition, since COPD is a typical disease of the elderly, comorbidities (chronic heart failure, diabetes, osteoporosis, depression) contribute to the severity of this disorder. Smoke is a powerful inducer of inflammatory response and also alters normal lung-repair responses, hence favoring tissue destruction. Abnormal repair can lead to the peribronchiolar fibrosis that causes airflow limitation in small airways. In addition, inflammation associated with COPD causes damage to the mucociliary transport system, which is responsible for clearing mucus from the airways. Both of these factors contribute to excess mucus secretion in the airways, which eventually accumulates, worsening airflow. The inflammation of the lower respiratory tract may also contribute to the development of fixed airway obstruction. Airway remodeling in COPD is a direct result of the inflammatory response and leads to narrowing/obstruction of the airways. The destruction of the structures supporting and feeding the alveoli causes a loss of lung tissue elasticity (emphysema). Thus, the small airways collapse during exhalation, impeding airflow, trapping air in the lungs, and reducing functional lung capacity while increasing the residual volume. These mechanical aspects contribute together with hypoxemia to the severity of dyspnea.

The presence of emphysema increases the normal tendency of the narrowing of the caliber of intraparenchymal airways on expiration because airway walls are more compressible. Over the long term, this causes lung hyperinflation (evidenced by increased residual volume and total lung capacity) and decreases lung functional capacity (evidenced by reduction in maximal expiratory flow, in turn due to loss of lung elastic recoil and airway obstruction). This, in turn, leads to progressive loss of diaphragm muscle function. The loss of alveolar-to-capillary surface area and the airway obstruction lead to impaired gas diffusion capacity (DLCO). Ultimately, hypoxemia and hypercapnia develop and lead to respiratory failure.

COPD is primarily a disease of the lungs, but it can be regarded also as a systemic inflammatory disorder. Muscular weakness, increased risk for atherosclerotic vascular disease, depression, osteoporosis, obesity, and abnormalities in fluid and electrolyte balance may all be consequences or comorbidities of COPD (see below: Interaction between chronic diseases, respiratory reflexes, autonomic imbalance, and peripheral muscle/systemic involvement).

Asthma

Asthma is the result of complex interactions between airways smooth muscle, remodeling, inflammation, lung mechanics, and breathing pattern. This condition is due to inflammation of the airways, involving the response of the local nervous regulation of bronchial caliber. This leads to the well-known phenomenon of bronchial hyper-responsiveness. During attacks, the bronchial smooth muscle contraction and the mucus hypersecretion cause airway narrowing, thus reducing the flow of air in, and particularly out, of the lungs. Obstruction to flow can resolve either spontaneously or as a result of treatment, but chronic inflammation keeps the airways hyper-responsive to specific (allergens, occupational substances) or nonspecific (cold air, exercise, anxiety/stress) stimuli.

Independent of the triggering stimulus, an asthmatic person has to make a much greater effort both to breathe in air and to expel it. Lung function during an attack includes a decrease in flow and airway conductance, associated with an increase in functional residual capacity that causes an increase in the respiratory elastic work of breathing. The increase in residual volume parallels the decrease in vital capacity, thus implying the occurrence of airway closure, a marker of severity of the disease. There is no preferential site of narrowing, and either peripheral or central airways may undergo narrowing. However, recent research emphasizes the role of the uneven distribution of ventilation and the role of small airways.

In between asthma attacks lung function can be normal. However, if the disease progresses, both the frequency and severity of attacks increase, and during the inter-critical period, lung function progressively worsens, becoming more and more similar to that of COPD. Very rarely (near-fatal asthma), the condition may progress to respiratory failure requiring mechanical ventilation. Although exceptional, asthma can be a fatal event, especially when its severity is not promptly recognized.

While COPD and asthma develop from different causes, their individual evolutions over time show a tendency to converge and intersect. Thus, the effect of chronic inflammation might often aggravate attacks of bronchoconstriction in COPD. Similarly, the slow worsening of asthma ultimately leads to chronic inflammation, which leads to chronic bronchoconstriction that becomes less and less reversible with bronchodilator therapy. In the same way, mechanical abnormalities develop in both conditions.

Rationale for the use of yoga in asthma and COPD

Bronchial tone, deep breathing, and parasympathetic activity

High resting sympathetic tone and high parasympathetic tone are well-accepted negative and positive clinical prognostic markers, respectively, in most cardiovascular diseases. Paradoxically, the parasympathetic activation constricts the airways and thus seems to make respiration more difficult. The significance of this is not obvious. Unless we postulate that parasympathetic control acts independently on the two systems, this seems contradictory. In addition, some degree of resistance in the bronchial tree is essential to maintain the particular gas composition present in the alveoli (with no resistance between alveoli and external air, this would be impossible). Different parasympathetic stimuli (oxygen, direct stimulation of carotid baroreceptors, slow breathing) do show some degree of bronchoconstriction (Dellacà, Zannin, diToro, Pellegrino, & Bernardi, 2014) despite improved cardiovascular conditions. Yet, during slow breathing the bronchoconstriction is contrasted by a direct effect of lung inflation that causes bronchodilation (Milanese et al., 2009). Thus, slow deep breathing (DB) has the effect of dilating the airways, at least in healthy subjects, and is potentially beneficial in asthma. In yoga, DB is widely practiced not only during pranayama but also during different asanas, in which the respiration-linked movements actually reduce breathing rate.

However, the feasibility of using DB for the therapy of asthma (particularly as a preventive intervention before asthma attacks) remains to be clarified. In patients with asthma, DB-induced improvement in airway conductance is blunted, and during asthma attacks DB could paradoxically hyperventilate alveoli that are already ventilated, at the expense of hypoventilated ones (Brusasco & Pellegrino, 2003). On the other hand, this adverse effect could be theoretically prevented by the use of *ujjayi* pranayama combined with DB, due to an increase in intrathoracic pressure. To our knowledge, no studies have examined this potential effect of yoga in COPD or asthmatic patients, and a final assessment of any potential benefits and/or contraindications is needed.

Diaphragm

A major effect of lung hyperinflation is impairment of the use of the diaphragm. Hyperinflation causes the diaphragm to flatten, so its contraction (which expands the lungs by lowering its base during inspiration) becomes less and less effective. When the diaphragm is flattened, its contraction actually causes a paradoxical lung reduction during inspiration. This abnormality in turn fuels hyperinflation in a vicious cycle. Exercises aimed at improving, or at least retarding, this progression might be potentially crucial in preventing functional deterioration of the lungs and ultimately respiratory insufficiency. Various pranayama techniques might lead to a more appropriate use of the respiratory muscles, but their range of potential efficacy still needs to be fully tested. For example, *kapalabhati* could be of potential help in emptying the lungs and preventing hyperinflation (because of the active expiration elicited by the abdominal muscles during the pranayama technique), but to date no studies appear to have been conducted to evaluate this hypothesis.

Interaction between chronic diseases, respiratory reflexes, autonomic imbalance, and peripheral muscle/systemic involvement

Recent research indicates a common pathway in which asthma, COPD, and other chronic diseases (heart failure, obesity, and metabolic syndrome/diabetes) tend to converge through a common effect on the skeletal muscle. Skeletal muscle is affected by physical deconditioning, a common consequence of most chronic diseases. In fact, physical deconditioning triggers a generalized tendency to inflammation, insulin resistance (and related reactive-oxygen species accumulation and endothelial dysfunction) and sympathetic hyperactivation/parasympathetic deactivation (Piepoli & Coats, 2013). Physical deconditioning in turn alters the main respiratory (i.e., chemo-) and cardiovascular (i.e., baro-) reflexes and stimulates dyspnea during physical exercise (as observed in the case of heart failure). The increased tendency to dyspnea in turn forces patients to be less active and this creates a vicious cycle in which physical deconditioning, dyspnea, inflammation, insulin resistance, sympathetic activation, vascular constriction, and endothelial dysfunction progressively worsen.

Thus, regardless of the initial disease, the involvement of the mechanisms described above prediposes patients to new comorbidities: for example, a patient with COPD might eventually develop hypertension or heart failure or diabetes, or a patient with diabetes might develop COPD. The exaggerated ventilation triggered by sympathetic activation is an adverse prognostic factor in heart failure (Piepoli & Coats, 2013). DB has been investigated as a potential means to correcting the abnormal respiratory reflexes. Practicing DB has been shown not only to improve gas exchange but also to improve exercise capacity and dyspnea, which are the main compromising symptoms of heart failure (Bernardi et al., 1998).

In the conditions above, enhancing breathing efficiency reduces sympathetic activity while at the same time strengthening parasympathetic activity, as evidenced by improved baroreflex sensitivity. Interestingly, similar effects have been the goal of pharmaceutical treatment (beta blockers and angiotensin-converting enzyme (ACE) inhibitors) or electronic implantable devices (baroreflex or vagal nerve stimulators, see for example Yamakawa et al., 2013). Improved parasympathetic activity not only results in better control of blood pressure but also of inflammation, endothelial dysfunction, and insulin resistance (Vecoli & Paolocci, 2008). These mechanistic studies provide multiple specific hypotheses for the use of yoga or physical activity (e.g., rearrangement of cardiorespiratory reflexes and modulation of inflammation/insulin resistance/oxidative stress/endothelial dysfunction, improving of muscle strength), most of which still await testing in clinical studies.

Muscle strength

Because physical deconditioning also involves the respiratory muscles, any intervention able to maintain the conditioning of these muscles could be potentially helpful. In turn, respiratory muscle fatigue might aggravate asthmatic attacks. Yoga-derived breathing techniques involving the use of the diaphragm could retard or maybe even reverse the progression of the hyperinflation and thus the progression of the disease and the onset of respiratory insufficiency. Since reduced muscle strength and coordination is common in both asthma and COPD, any activity promoting coordination and respiratory muscle activity (as is typically achievable with yoga) could be potentially useful in both diseases.

Deep breathing, blood gas exchange, and respiratory/cardiovascular reflexes

Slowing the breathing rate reduces the effect of anatomical dead space (which is dependent on respiratory rate) and thus improves alveolar ventilation. The increased depth of breathing caused by slower pacing/frequency reduces the ventilation/perfusion mismatch (physiological dead space). This is likely due to a better perfusion of upper lung areas and better ventilation of lower lung areas (hence increasing the effective alveolar ventilation) (Bernardi et al., 1998), and also to improving DLCO by recruiting more alveoli and thus enlarging the total gas-exchange surface.

Although slowing of the breathing rate is compensated by an increase in tidal volume, minute ventilation is reduced in people adapted to this type of exercise (yoga practitioners), due to the same alveolar ventilation obtained with lower dead spaces. Either due to the causes noted above or independently, slow breathing reduces chemoreflex sensitivity (Spicuzza et al., 2000) and improves baroreflex sensitivity (Bernardi et al., 2001). This in turn reduces sympathetic activity (Raupach et al., 2008), which seems an important (yet still little considered) problem in COPD as well as in other chronic diseases such as heart failure. For all of these reasons, DB alone or DB associated with other yoga practices seem to act beneficially on the many pathologic mechanisms described above.

Lifestyle

COPD is strongly influenced by smoking. In addition, because of respiratory problems and frequently associated comorbidities, patients with COPD tend to be sedentary. As such, any forms of physical activity that do not expose patients to cold dry air/pollutants and allergens might induce beneficial results. Thus, yoga could be seen as an alternative physical exercise. Yoga practitioners typically adopt healthier behaviors, and yoga seems to hold promise for smoking cessation (Dai & Sharma, 2014).

Psychological aspects

Psychological dysfunction is more common in people with asthma compared to healthy individuals. A recent survey of over 85,000 adults in 17 countries reported that the age-adjusted and gender-adjusted odds of mental disorders among people with physician-diagnosed asthma relative to those without was 1.6 for depressive disorders and 1.5 for anxiety disorders (Scott et al., 2007). Asthma may both precede and be predisposing for anxiety and depression. Alternatively, psychological and behavioral problems may precede and be predisposing for asthma.

At the behavioral level, the negative impact of anxiety and depression on pre-existing asthma is characterized by (1) various poor self-management behaviors, such as overuse of bronchodilator medication, poor adherence to controller therapy, poor relationships with health professionals, and indulgence in at-risk behaviors such as smoking; (2) hyperventilation, especially in the case of anxiety, which can either result in asthma-like symptoms or act as a trigger for asthma; and (3) altered symptom perception, with enhanced awareness of breathlessness and bronchoconstriction and therefore increased distress (see Thomas, Bruton, Moffat & Cleland, 2011, for a review).

At the physiological level, psychological stress can affect (1) the release of cortisol and the expression of inflammatory mediators, resulting in increased airway inflammation; (2) immune regulation, first by reducing the activity of natural killer cells, and second by promoting a shift from type 1 to type 2 cytokine predominance, therefore favoring the inflammatory milieu; and (3) allergic symptoms, for example by increasing the skin wheal response (see Wright, 2005, for a review).

The practice of mindfulness is an effective tool for stress management, and it can be employed to reduce the impact of the psychological factors on asthma. Notably, the benefits of the 8-week Mindfulness-Based Stress Reduction program on asthma-related quality of life have been documented up to 12-month follow-up (Pbert et al., 2012). In line with the connection between psychological stress and immune regulation, yoga has been shown to have multidimensional beneficial effects on immune-response regulation (Morgan, Irwin, Chung, & Wang, 2014).

Clinical research on yoga and asthma

Methodological aspects

With respect to published clinical trials of yoga and yoga-related interventions for asthma, some methodological problems are of special relevance. A double-blind design is not practically applicable, and in only a few cases has a single-blind approach been applied. In addition, the choice of an appropriate control or comparator is problematic: a true placebo (sham) yoga intervention is difficult to design. Thus, in clinical trials surrogate controls are used (e.g., meditation, group therapy, postural exercises, or no intervention at all). This fact is not of negligible importance, since a placebo effect can account for up to 30% of the observed effects in a clinical trial. In the case of asthma, in the majority of randomized controlled trials (RCTs), yoga interventions are evaluated as an add-on treatment. In this research design, all subjects receive a standard pharmacological therapy for asthma, and yoga is given to the active treatment group but not to the control group, thereby complicating the interpretation of any results. Research with traditional pharmaceutical trials involves a single principle or a few active principles in the mechanism of treatment action, whereas in the case of yoga there are numerous different techniques than can be applied alone or in combination (e.g., breathing techniques, posture, meditation, relaxation, etc.), which complicates interpretation of efficacy. Furthermore, the duration of yoga treatment in the research literature is widely variable, often reflecting the personal preference of investigators or yoga teachers/therapists. Finally, research on asthma is complicated by the fact that it is a disease intrinsically varying over time, requiring regular evaluations and therapeutic adjustments, and different phenotypes of asthma exist, characterized by severity, biology, and response to drugs. All these aspects introduce special difficulties in the methodological evaluation of trials of yoga for asthma, since a complex intervention and a complex disease are being evaluated at the same time.

Yoga and asthma: the evidence

Yoga techniques in general have progressively gained interest as possible therapeutic approaches in many chronic diseases, including the respiratory ones. The basic yoga approaches in asthma are control of breathing, relaxation, and physical posture control. All these features affect the mechanical aspects of ventilation, the bronchial caliber, and the coordination of ventilatory muscles. In addition, due to the very complex interactions among psyche, perception, neurohumoural (autonomic) regulatory systems, systemic inflammation, and stress that occur in respiratory disorders (Mourya et al., 2009), it is hypothesized that yogic approaches can lead to better autonomic function, and in particular, to a decrease in inflammatory responses (Morgan et al., 2014).

Pioneering reports on the effects of yoga on breathing patterns and asthma in general first appeared in the 1960s (e.g., Bhole, 1967). The interest in this area began to increase in the 1990s (Lane & Lane, 1991), and evidence-based studies have been performed primarily during the last 20 years. We evaluated the available clinical trials, restricting the search to RCTs (either blinded or not), published in English, with methods fully described. Case reports, opinions, and commentary/editorials were not considered. An extensive literature search in MedLine (using search terms “asthma” and “yoga”) retrieved 90 articles, of which 13 could be identified as RCTs (see Table 15.1 , p. 326). The Jadad scoring system was applied to semi-quantitatively assess the quality of evidence.

In the earliest controlled study (Nagarathna & Nagendra, 1985), 106 patients were allocated to an active and a control group. The active group was trained to use different yoga techniques (relaxation, breathing, posture, meditation), whereas controls continued with usual standard of care. After a 54-month follow-up there was a significant decrease of asthma attacks and use of inhaled medications, with an improvement in peak expiratory flow rate (PEFR) in the active group versus baseline and controls. A strength of the study was the long follow-up period. There were some limitations regarding the randomization and the method for patient selection, the scoring for medication usage, and the lack of interim analyses. Singh and colleagues (Singh, Wisniewski, Britton, & Tattersfield, 1990) performed a crossover study (2 weeks per phase) using a mechanical device (Pink City Lung Exerciser, PCLE) that mimics the slow expiration of pranayama breathing. A placebo device served as control. The results showed an increase in histamine bronchial provocation dose in the active group (i.e., a higher threshold for bronchoconstriction), but no significant difference versus baseline for both treatments in FEV1 (forced expiratory volume in the first second) and PEFR. Similar results were obtained in another small study conducted in 17 patients with breathing/posture exercises for 4 months (Vedanthan et al., 1998). A good-quality study (randomized, controlled, and single-blinded) comparing Sahaja yoga to an active control treatment of relaxation, group discussion, and cognitive behavior therapy-like exercises, found no substantial difference in quality of life (QoL), but the hyperresponsivity to metacholine improved significantly in the yoga as compared to control group, and the effect size was approximately similar to that of inhaled corticosteroids. However, the positive effects were no longer present at a 2-month follow-up (Manocha, Marks, Kenchington, Peters, & Salome, 2002). Cooper et al. (2003) in a single-blind, randomized controlled, three parallel-group trial, compared the effects of Buteyko breathing (a respiratory technique resembling yoga exercises), PCLE, and placebo PCLE for 6 months. A reduction in symptom score and intake of bronchodilators was shown only in the Buteyko group. There were no measurable differences in FEV1, methacholine challenge, exacerbations, QoL, and inhaled corticosteroids between groups. This study should not be strictly considered a yoga trial, since artificial devices were used, but the high-quality experimental design and the rationale warrant its inclusion in the classical literature. A similar single-blind controlled trial of yogic breathing exercises versus stretching failed to detect a difference between the two treatment groups, although a parallel reduction in morning symptom score was seen in both groups throughout the 30 days of study (Sabina et al., 2005). Two small RCTs (fewer than 20 patients included) reported an improvement in QoL and a decrease of symptoms and use of bronchodilators (Mekonnen & Mossie, 2010; Bidwell, Yazel, Davin, Fairchild, & Kanaley, 2012). Three other studies published in 2009 (Sodhi, Singh, & Dandona, 2009; Vempati, Bijlani, & Deepak, 2009; Saxena & Saxena, 2009), including 50, 60, and 120 subjects, respectively, reported a consistent improvement in pulmonary function (FEV1, PEFR, and forced vital capacity) in the yoga groups. In a study by Vempati et al. (2009), several biochemical parameters (e.g., eosinophil cationic protein, urinary prostaglandins) were also assessed, but no significant change could be detected. However, Singh et al. (2012) reported that pranayama and yoga postures improved FEV1, PEFR, vital capacity, and diffusion capacity in the active group (30 + 30 subjects studied). The most recent study (Agnihotri, Kant, Kumar, Mishra, & Mishra, 2014) involved 276 participants with asthma randomly assigned to a yoga breathing exercise or pharmacotherapy alone for 6 months. The authors found a significant increase in hemoglobin and superoxide dismutase and a decrease of total white blood cells and eosinophils at the end of the study in the active group. Although the results are interesting, there was no clinical evaluation (symptoms, drugs, pulmonary function) in this study, so that no conclusion as to clinical efficacy can be derived.

A previous extensive meta-analysis by Posadzski and Ernst (2011) selected six RCTs and one nonrandomized clinical trial (NRCT) that met their inclusion criteria. In four out of the seven studies they found that yoga was more effective than control interventions in reducing airway hyperresponsivity, the weekly number of asthma attacks, and the need for drug treatment. On the other hand, three RCTs showed no positive effects of yoga compared with various control interventions. However, the authors defined the methodological quality of these studies as “poor” and concluded, “The belief that yoga alleviates asthma was not supported by sound evidence” and “more rigorous trials are warranted.”

A more recent meta-analysis by Cramer et al. (Cramer, Lauche, & Dobos, 2014) found 14 RCTs on asthma and reported an extensive heterogeneity of interventions, patient selection, and protocols, but failed to comment on the specific outcome results.

Clinical research on yoga for chronic obstructive pulmonary disease (COPD)

Methodological aspects

As is the case for asthma, the evaluation of any intervention for COPD should also be rigorous, given that this disorder is a high-prevalence condition. Asthma and COPD share the basic pathogenic mechanism of an obstruction or limitation to airflow, although this is reversible in asthma and poorly or not reversible at all in COPD (Global Initiative for Obstructive Lung Disease, 2014). Overall, COPD is in its clinical presentation a relatively homogeneous disease, although different clinical phenotypes have been identified, with some of these overlapping with comorbid asthma.

Much more so than in asthma, the mechanical factors related to progressive hyperinflation, loss of elastic recoil, and altered breathing pattern contribute to clinical symptoms. Furthermore, this disease slowly worsens over time. Many pharmacological treatments, in addition to smoking cessation, are currently available, including short- or long-acting beta2 agonist (SABA, LABA), antimuscarinic agents (SAMA, LAMA), phosphodiesterase type 4 selective inhibitors, inhaled corticosteroids (ICS), and teophyllines (Global Initiative for Obstructive Lung Disease, 2014). All of these treatments have been shown capable of delaying lung function decline, to prevent or reduce exacerbations, but without or with few significant changes in the natural history. In such a condition (chronic and progressive disease, important mechanical alterations), it is reasonable to expect that approaches targeting the breathing pattern could be advantageous. In fact, pulmonary rehabilitation and respiratory training have been shown effective and of perceivable clinical benefit, and have been recommended as therapeutic approaches in COPD (Global Initiative for Obstructive Lung Disease, 2014).

Yoga involves not only posture, movements, and breathing but also meditation, thereby taking advantage of the body–mind connection. This would represent an added value in COPD patients, for whom depression is extremely frequent (Atlantis et al., 2013). Despite this, and the ascertained efficacy of physical and breathing exercises, yoga techniques have been rarely studied in COPD. This is probably due to the unfavorable prognosis, to comorbidities, and to the typical advanced age of patients, who frequently have difficulty in applying physical techniques. In addition, it is not clear which primary outcome should be chosen (pulmonary function, QoL, tolerance to exercise) to evaluate the trials appropriately—the use of a placebo (sham) intervention is difficult with yoga interventions, and also because of advanced age and comorbidities. Finally, due to the long-lasting course of the disease, it is difficult to identify a proper study observation interval. All the issues described above partially explain the paucity of clinical trials of yoga for COPD. The majority of the retrievable studies suffer from major methodological drawbacks, involving patient selection, analysis, and control conditions (when available).

Yoga and COPD: the evidence

A MedLine search (yoga [AND] COPD [OR] obstructive) returned 20 articles published in the English language, of which 8 were clinical trials (Table 15.2 , p. 328), and one which reported only a sub-analysis (Donesky et al., 2012). Of these, 4 were described as randomized and/or controlled (Table 15.2 , p. 328).

The five studies (Tandon, 1978; Kulpati et al., 1982; Behera, 1998; Katiyar & Bihari, 2006; Donesky-Cuenco et al., 2009) reporting FEV1 (as absolute value or % predicted), invariably showed an increase of this parameter at the end of the intervention as compared with the controls. Similarly, the two studies assessing the 6-minute walking test reported an increase in the mean distance at the end of yoga training. The improvement in QoL (measured with different instruments) were variable in magnitude across studies (Donesky-Cuenco et al., 2009; Santana et al., 2013; Fulambarker et al., 2012). One study evaluating mechanism (Soni et al., 2012) assessed the effects of yoga training on lung-diffusion capacity, showing an improvement with yoga training. There were also two randomized studies investigating the role of tai chi in COPD (Yeh et al., 2010; Ng et al., 2011). Both studies reported an improvement in QoL, though the improvement was more evident in the first study (10 patients) than in the second study (80 patients).

The overall quality of the trials was defined as “low” (Liu et al., 2014), with the majority of them open and prospective research designs without a control group, and the number of patients involved was small, ranging from 15 (Behera, 1998) to 75 (Kulpati et al., 1982). Also, in the randomized trials the randomization system was not always clearly reported. In addition, there was a large variability in the assessed parameters and trial duration across studies, and the severity of COPD was reported in only a few studies. Finally, the yoga interventions and controls (where present) were also very different.

In their recent meta-analysis Liu et al. (2014) identified five RCTs matching their inclusion criteria. They found that yoga training significantly improved FEV1 and 6-minute walking test, concluding that “yoga training has a positive effect on improving lung function and exercise capacity and could be used as an adjunct pulmonary rehabilitation program in COPD patients,” though “further studies are needed to investigate the long-term effects of yoga training.” Norweg and Collins (2013) reviewed 23 COPD studies to examine the evidence for the effectiveness of cognitive–behavioral strategies for relieving dyspnea in COPD, and found that DB alone or combined with pursed-lip breathing (which is functionally similar to *ujjayi* pranayama) was effective in reducing dyspnea. Additionally, they reported that the American College of Chest Physicians consensus now recommends pursed-lip breathing for effective dyspnea relief.

Concluding considerations

Looking at the literature available, and considering only the RCTs published in English, some general conclusions can be drawn. In general, there is wide variability and heterogeneity in the study designs, in particular concerning the duration of the trials and of the yogic intervention applied, that weakens the interpretation and prevents unequivocal evaluation of the results. In addition, in many studies the methodological quality was moderate or low, due to the insufficient description of the procedures, symptoms, and drugs used, randomization procedures, and statistical analysis. Of note, the studies with the higher quality score (Table 15.1 , p. 326) generally failed to detect a significant effect of the intervention studied. These considerations are in agreement with the results provided by some meta-analyses (Posadzki & Ernst, 2011; Cramer et al., 2014).

On the other hand, experimental studies indicate a large number of potential benefits for the use of yoga practices in respiratory diseases, particularly in COPD, and also in the crucial respiratory involvement of other relevant diseases such as congestive heart failure. Linking clinical research with pathophysiological mechanisms underlying these conditions is a fruitful direction for future research. Novel RCTs could be designed around specific pathophysiological hypotheses, thus benefiting both applied and basic research and promoting the advancement of the field of yoga research as a whole.

Table 15.1 Asthma, randomized controlled trials

Author, year	Pats* (dropouts)	Age	Intervention	Control	Duration	Jadad score	Main results**
Nagarathna, 1985	53/53 (14/15)	9–47	Pranayama + dyhana + yogasana	No yoga, drugs only	2 wk training 1 hour/day follow-up 54 m	3	↑ PEFR, ↓ drugs, ↓ weekly att vs. contro group at t end of foll up
Singh, 1990	18 (crossover)	18–47	Pranayama with PCLE**	PCLE placebo	2 wk; 15 min twice daily	4	No differe between placebo a active in l function; response bronchial histamine active
Vedanthan, 1998	9/8 (0/0)	19–52	Pranayama + yogasanas	No yoga, drugs only	16 wk; 1 hr 3 times/week	3	No statisti significant difference between groups
Manocha, 2002	30/29 (9/3)	18–54	Sahaja yoga	Relaxing technique	4 mo 2 hrs/week	5	No effect symptoms of rescue medicatio and asthm related Q
Cooper, 2003	29/30/30 (7/7/6)	18–70	Buteyko and PCLE breathing	PCLE placebo	6 mo; 15 min twice daily	4	No effect FEV1, exacerbat use of corticoste ↓ sympto and bronchodi with Butey only
Sabina, 2005	31/31 (10/7)	18–65	Yoga postures/breathing	Stretching	1 mo	4	↓ Morning symptoms both grou difference between groups in drug intak and QoL
Sodhi, 2009	60/60	Adult	Breathing exercise	No yoga, drugs only	2 m	3	↑ FEV1, P FVC in the active gro only
Vempati, 2009	30/30 (1/2)	18–58	Pranayama + shawasana + yogasana	No yoga, drugs only	2 mo 1–2 hrs/week	4	↑ FEV1 ar PEFR in ac group vs. baseline a

							controls. N change in eosinophil cationic p ↓ respons exercise challenge QoL in bot groups
Saxena, 2009	25/25	18/45	Various postures/ breathing techniques	Meditation	3 mo; 20 min twice daily	3	↑ FEV1 an PEFR; ↓ symptoms active vs. baseline a controls
Demeke, 2012	12/12 (0/0)	11–51	Yoga (relaxation, breathing)	No yoga, drugs only	4 wk 1 hr/day	2	↓ daily at and use o bronchodi
Bidwell, 2012	10/9	18–57	Various yoga exercises	No yoga, only drugs	10 wk	3	↑ QoL (Sa George Respirator Questionn
Singh, 2012	30/30	Adult	Pranayama/postures	No yoga, only drugs	2 m	3	↑ FEV1, P vital capa in the acti group
Agnihotri, 2014	138/138 (17/18)	12–60	Multiple yoga techniques	Drugs only	6 mo 30 min/day	4	↑ hemogl and SOD, eosinophil total white cells vs. baseline a control gr

*Active/control; **PCLE: Pink City Lung Exercise; ***FEV1: forced expiratory volume in 1 second; PEFR: peak expiratory flow rate; QoL: quality of life; SOD: superoxide dismutase.

Table 15.2 Chronic obstructive pulmonary disease, randomized controlled trials					
Author, year	**Study design**	**Pats**	**Interventions**	**Evaluated parameters**	**Main results**
Tandon, 1978	Open, controlled, single blinded	12 active 12 control	Yoga breathing/posture vs. physiotherapy 1 hr, weekly for 9 mo	FEV1, FVC, arterial O_2 , working tolerance, self-evaluation	No change between groups in FEV1, FVC, arterial O_2 . ↑ tolerance to exercise only in yoga group. More patients subjectively improved in yoga group
Kulpati, 1982	Randomized controlled	25 active 50 control	Pranayama breathing 30 min twice daily for 12 wks vs. usual care	FEV1, FVC, arterial O_2 and CO_2	↑ FEV1 and FVC. No change in blood gases
Behera, 1998	Open prospective	15	Yoga postures 1 hr/daily for 4 wks	FEV1, PEFR, dyspnea	↑ FEV1 and PEFR. Improvement of dyspnea on VAS scale
Katiyar, 2006	Randomized controlled	23 active 22 control	Pranayama breathing 30 min daily for 3 mo vs. usual care	FEV1, 6 min walking test	↑ both
Donesky-Cuenco, 2009	Randomized controlled	20 active 21 controls 12 dropouts	Breathing/posture/stretching 1 hour, 2 times/wk for 3 mo vs. standard care	Dyspnea intensity/distress at 6 min walking test, QoL, FEV1 depression index	↓ dyspnea distress, ↑ walking distance and QoL vs. controls. No significant difference between groups in FEV1, anxiety-depression and other dyspnea indexes
Fulambarker, 2012	Open prospective	33 enrolled 20 completed	Posture/breathing; 1 hr, 3 times/wk for 6 wks	QoL, maximal pressures, tidal volume	↑ QoL by Saint George Respiratory Questionnaire, tidal volume and maximal pressures versus baseline
Soni, 2012	Randomized controlled	30 active 30 control	Posture/breathing 1 hr/day for 2 mo	CO transfer	↑ TLCO versus baseline only in active group. No difference between subgroups of different severity
Santana, 2013	Open prospective	18*	Posture exercises 2 hrs 2 times/wk for 3 mo	Walking test, anxiety scale, QoL, utility scores	No change in the evaluated parameters except for ↑ in anxiety–depression

*Only 6 patients with COPD.

COPD: chronic obstructive pulmonary disease; FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity; PEFR: peak expiratory flow rate; QoL: quality of life; TLCO: transfer factor of lung for carbon monoxide; VAS: Visual Analog Scale.

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Respiratory conditions: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Beyond its role in gas exchange, Judith Hanson Lasater says that breathing “is also a motor activity, requiring the coordination of muscles, bones, and joints. Besides the diaphragm, there is the muscular action of the intercostals and slight activity needed in the scapular elevators and perhaps of the erector spinae to facilitate inhalation. All of this requires slight thoracic extension, or at least a normal thoracic curve. There is also flexibility needed in the costal joints of the sternum and vertebrae and the sternoclavicular and acromioclavicular joints.”

Ananda Balayogi Bhavanani says that among yoga therapy patients with COPD, “Physical and mental agitation, emotional volatility, and a predominance of the *kapha dosha* are seen regularly.” In ayurveda, conditions with lot of mucus production are typically linked with kapha. He says he also sees “a tendency to be withdrawn and self-conscious. We use yogic counseling sessions to help them understand the source of these agitations and the role of their stress response in aggravating it. Adoption of *pratipaksha bhavanam* [developing opposite attitudes, as advised by Patanjali] toward life situations is cultivated in a step-by-step manner."

Anukool Deval reports that many patients with COPD lack strength and stamina. Their breath tends to be shallow, effortful, and faster than normal. Therapeutically, he favors basic breathing practices and simple versions of poses like cobra pose (*bhujangasana*) and bow pose (*dhanurasana*), which stretch the chest region. He advises his clients to breathe deeply, if possible, while performing the poses.

Lasater observes that patients with COPD are usually not ready for pranayama, "which might seem like the first obvious choice." Even the simplest breathing practices, she has found, are sometimes too much, because their kyphosis can be so advanced that they are unable to achieve a proper *tadasana* (mountain pose). "Their posture in and of itself interferes with proper, normal breathing, not to mention the added problem of COPD. So my first treatment goals are to stretch the intercostals and mobilize the thoracic spine and shoulder joint area."

Among the poses that Lasater has had good results with are tadasana, which she reports is often "actually a backbend for those with kyphosis," half dog-pose at the wall, *trikonasana* (triangle pose), and side-bending while standing with arms overhead and fingers interlocked, which can also be done seated on a chair. She favors simple backbends such as cobra, as well as lying supine over a couple of folded blankets. She also likes *bharadvajasana* (a chair twist) to stretch the intercostal muscles. She finds it important to stretch the pectoralis muscles. Helpful for this is standing near the wall, the arm abducted to 90 degrees and the hand flat on the wall, and *jathara parivartanasana* (revolved-abdomen pose) “with an emphasis on stretching superior–lateral chest wall if the patient can easily get onto and up from the floor.” (See Figs 15.1 and 15.2 .)

Lasater also commonly employs restorative poses in respiratory patients, for example, a supported *supta baddha konasana* (reclining cobbler’s pose). For this pose, she will use enough bolsters, blocks, and/or folded blankets to elevate the student’s torso at a 45-degree angle, and will also support the knees and the arms. If the knees are uncomfortable for the student, she will typically substitute supported reclining pose, “which is the same set-up as *supta baddha konasana* but the legs are extended over the bolster in a semi-straight position.”

Lasaster recommends doing breathing practices in *savasana* (corpse pose) with the trunk and head elevated with blankets folded lengthwise, a bolster under knees, and a rolled blanket under the Achilles tendons. She suggests focusing on “elongating the exhalation to strengthen respiratory muscles and allow for fuller inhalation, much as we do for people with asthma. Focus is not on length of breath so much as making the exhalation longer than the inhalation.”

Figure 15.1

Tadasana, mountain pose, can feel like a backbend for patients with COPD.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Figure 15.2

Side stretches can be done standing or seated. In this variation, a strap is used between the forearms, rather than interlocking the fingers, which may be easier for students with tight shoulders.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Bhavanani recommends “a series of techniques known as the *hathenas* that facilitate the proper utilization of all sections of the lungs.” Different hathenas affect different areas of the lung, and the ones used depend on the area the yoga therapist hopes to stimulate. For example, hathenas to increase efficiency in the lower chest area are based on *ustrasana* [camel pose] to “help force the inhaled air primarily into the lower lung area, expanding and stretching the lung tissue. These hathenas condition the respiratory system to perform conscious and efficient lower chest breathing.”

Bhavanani often recommends slow, regular, deep breathing with an emphasis on sectional breathing. He also recommends *bhramari* (bee breath) and *pranava* pranayama. Pranava is repetition of the mantra *om* , which can also be written *aum* . The breath exits the lower lungs as the student chants the “a” sound (pronounced “ahhh”), the middle lungs with the “u” sound (rhymes with “who”), and the upper lungs with the “m” sound (pronounced “mmm”). In addition, “an anti-kapha diet,” he says, “is essential to help in healing and to prevent the condition from flaring up again and again. A vegan diet would be quite ideal for these individuals.”

Jnani Chapman has had good results with the guided relaxation technique *yoga nidra* in patients with emphysema. She reports that although the practice does not seem to improve the lung condition per se, her student's ability to carry out their day-to-day activities sometimes improves dramatically. To begin, she asks the student to recline in a supine position on the floor or even in bed. They should make themselves as comfortable as possible, "with support under knees and neck."

Chapman teaches "the progressive yoga nidra practice of bringing the attention to each set of muscles individually." She'll name a particular muscle and instruct the student to stretch it out as they inhale. She'll say, "Hold the breath in as you lift that muscle only an inch or so in the air and then squeeze that muscle with vigor. After a few seconds of squeezing, release it down on a complete exhalation." Next, she'll guide the student "through a minute of breath awareness and a minute of watching the thoughts pass across the mind." She ends with a full 5 minutes of silence, with no music or external distractions, to allow her clients to rest in a blissful state.

Resources

Book: *Relax and Renew* by Judith Hanson Lasater

Book: *Correction of Breathing Disorders through Rishiculture Ashtanga Yoga* by Ananda Balayogi Bhavanani

SECTION 6

CANCER

From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.21b. © The Trustees of the Chester Beatty Library, Ireland.

CHAPTER SIXTEEN

YOGA THERAPY DURING CANCER TREATMENT

SC DANHAUER • SJ SOHL • EL ADDINGTON • A CHAOUL • L COHEN

Introduction

Pathophysiology, etiology, and prevalence of cancer

Cancer is not a single disease but a group of diseases with the common characteristic of abnormal cell growth. Cancer is typically found within specific organs (e.g., prostate, breast, colon, etc.) and when confined to the primary organ is usually not fatal. However, when cancer spreads outside the primary site (i.e., metastasizes), there is an increased likelihood of cancer-related mortality. Cancers can also include abnormal cell growth within white blood cells; collectively called blood cancers, these include leukemia, lymphoma, and myeloma. Worldwide, cancers account for more than 8.2 million deaths a year and more than 14 million people being diagnosed annually (WHO, 2015).

Cancer and the other major non-communicable diseases (cardiovascular disease, type 2 diabetes, and respiratory diseases) are mainly caused by behavioral risk factors: high body mass index (BMI), tobacco use, physical inactivity, unhealthy diets, and excessive use of alcohol (WHO, 2015). These same factors can influence cancer outcomes (Thomson et al., 2014; Vergnaud et al., 2013). Moreover, chronic stress and depression can have both direct and indirect effects on cancer by changing our biology and influencing behaviors (Lutgendorf & Sood, 2011; Thaker et al., 2006; Armaiz-Pena et al., 2013).

People treated for cancer typically undergo one or more of the following treatments: surgery, chemotherapy, radiotherapy, hormonal blockade, and other pharmacological treatment (e.g., targeted therapies). Common side effects of these treatments include complications from surgery such as lymphedema; chemotherapy-induced nausea and vomiting; fatigue; pain; chemotherapy- or surgery-induced peripheral neuropathy (pain, tingling, numbness in hands/feet); sleep disturbances; chemotherapy-induced cognitive impairment; mood disorders; and chemotherapy-induced immunosuppression. Cancer diagnosis and treatment are also associated with distress and fear of disease progression, recurrence, and death. Some consequences of cancer are temporary, but many persist, leaving patients to manage them long term. Further, these effects increase patients' vulnerability to other illnesses.

The use of yoga in cancer

Surveys examining the use of complementary and alternative medicine (CAM) in oncology populations usually do not differentiate patients who are undergoing active treatment from those not on treatment at the time of the survey. These observational studies indicate high rates of overall CAM use in cancer survivors in the United States, with estimates of at least 50% using some form of CAM (Mao, Palmer, Healy, Desai, & Amsterdam, 2011; Fouladbakhsh & Stommel, 2010). In the United States, yoga is among the most popular complementary modalities for men and women with cancer (Fouladbakhsh & Stommel, 2010). Nonetheless, the proportion of cancer survivors who have used yoga tends to be low (9.8% ever and 5.5% past year) (Mao et al., 2011). Interestingly, participants reported fewer barriers to participation in yoga than more traditional exercise programs (van Uden-Kraan et al., 2013).

Psychophysiological rationale for the use of yoga for cancer

People with cancer may turn to mind–body practices such as yoga before, during, and after cancer treatment to manage symptoms of cancer, side effects of treatment, or stress. Research shows that chronic stress affects almost every biological system in our bodies (Chrousos & Gold, 1992). Stress-related changes in immunity are especially relevant to people with cancer and may include decreased cell-mediated immunity and increased inflammatory cytokines (Lutgendorf & Sood, 2011). Cell-mediated immunity helps control malignant cells as they arise in the body, fights off viruses, and more. Inflammatory processes are associated with increased risk of cancer and worse outcomes for those with cancer (Wu, Antony, Meitzler, & Doroshow, 2014), as well as with cancer-related symptoms (e.g., fatigue, sleep disturbances, cognitive dysfunction, peripheral neuropathy) (Bower & Lamkin, 2013). The causal association between inflammation and cancer-related symptoms is uncertain, but both stress and specific cancer treatments can result in increases in inflammatory cytokines that lead to persistent and long-term symptoms (Bower & Lamkin, 2013). If stress-reducing interventions such as yoga can decrease the effects of stress on inflammation (Kiecolt-Glaser et al., 2014; Bower & Lamkin, 2013), perhaps they will also reduce symptoms.

Unmanaged chronic stress can also speed the aging process through telomere shortening, which itself is a risk factor for cancer (Epel et al., 2004). While chronic stress may not affect cancer initiation, extensive evidence suggests that chronic stress can promote cancer growth and progression (Satin, Linden, & Phillips, 2009; Armaiz-Pena et al., 2013). The underlying mechanisms for such effects are complex and involve chronic activation of the sympathetic nervous system and the hypothalamic–pituitary–adrenal (HPA) axis (Lutgendorf & Sood, 2011). Sustained elevations of hormones released from these pathways (e.g., norepinephrine, cortisol) can result in diverse effects, including stimulation of cancer invasion, angiogenesis, inflammation, reduced anoikis, and even reduced efficacy of chemotherapy drugs (Lutgendorf & Sood, 2011; Armaiz-Pena et al., 2013). The underlying signaling pathways offer opportunities for designing new therapeutic approaches for disrupting the effects of stress biology on cancer biology and include both biobehavioral and pharmacological (e.g., beta blockers) approaches (Lutgendorf & Sood, 2011). Yoga is one such approach.

Review of published research

Several recent reviews and meta-analyses have evaluated the benefits of yoga in cancer patients and survivors (Buffart et al., 2012; Harder, Parlour, & Jenkins, 2012; Lin, Hu, Chang, Lin, & Tsauo, 2011; Buffart et al., 2012; Cramer, Lange, Klose, Paul, & Dobos, 2012). The summary below describes yoga intervention research for people *during* cancer treatment. (The use of yoga for post-treatment cancer survivors is reviewed in Chapter 17 .) Studies are divided into nonrandomized trials (Table 16.1 , see p. 348) and randomized controlled trials (RCTs) (Table 16.2 , see p. 354). Table 16.3 (see p. 360) summarizes details of the yoga intervention protocol used in each study.

Nonrandomized trials of yoga during cancer treatment

Adult studies

Participant demographics

Six adult nonrandomized studies enrolled a total $N = 109$ (average $N = 18$) (Carson et al., 2007; Danhauer et al., 2008; Duncan, Leis, & Taylor-Brown, 2008; Galantino et al., 2012b; Milbury et al., 2014; Sohl et al., 2012) (Table 16.1 , see p. 348). Participants were primarily Caucasian (87%) and female (94%) with a variety of cancers (e.g., lymphoma, gynecologic, breast, lung) and represented all cancer stages. Treatments received while participating in the studies included chemotherapy ($n = 53$) and radiation ($n = 17$), when specified.

Intervention characteristics

Four studies specified yoga style, and two combined different yoga traditions (see Table 16.3 , p. 360). Most interventions included some combination of movement, breathing, meditation, and a component of yogic philosophy (Carson et al., 2007; Danhauer et al., 2008; Galantino et al., 2012b; Milbury et al., 2014; Sohl et al., 2012), whereas one study only described movements (Duncan et al., 2008). One intervention also included facilitated group discussions (Carson et al., 2007). Specific class sequences were presented in three of the six papers, with four studies indicating that the movements were adapted to individual needs. One study included an intervention manual and reviewed videotaped sessions to ensure treatment fidelity (Carson et al., 2007).

Dose of yoga was variable (i.e., ranges 3–15 sessions, 15–120 minutes, every 3 weeks to 3 sessions per week, duration 5–10 weeks). Four interventions were implemented as group classes, one with caregivers and patients, and one individually in the chemotherapy chair. In addition, four studies provided instructions for home practice.

Feasibility

Three studies reported recruitment rates ranging from 16% (letters sent) to 74% (approached in person) (Danhauer et al., 2008; Milbury et al., 2014; Sohl et al., 2012). Another study reported that recruitment challenges precluded study completion (Galantino et al., 2012b). Attrition rates from five studies ranged from 8% (selected from an ongoing yoga class) to 43% (selected from women receiving treatment), with reasons including traveling distance, change in interest, scheduling difficulties, and health issues (Carson et al., 2007; Danhauer et al., 2008; Duncan et al., 2008; Milbury et al., 2014; Sohl et al., 2012). In one study, those who completed the study had higher baseline levels of fatigue than those who withdrew, suggesting that higher levels of symptoms may motivate participation (Carson et al., 2007); however, another study found that patients who withdrew reported marginally significantly worse physical function at baseline than those who completed the study (Milbury et al., 2014).

Five studies with a range of 3–10 planned sessions reported adherence to in-person yoga sessions (Carson et al., 2007; Galantino et al., 2012b; Milbury et al., 2014; Sohl et al., 2012). Participants attended an average of 59–88% of the sessions. The study with the highest adherence rate included a group discussion component and was calculated based only on study completers (Carson et al., 2007). The second highest adherence rate (80%) was reported in a study of dyads (lung cancer patients with a family caregiver) (Milbury et al., 2014). In addition, three studies described participants' adherence to home practice. In a case study of four women, two participants had 80% adherence, whereas the other two had less than 50% adherence (Galantino et al., 2012b). One study found that individuals practiced at home a mean of 2.6 times (range 0–9) in between the 2–3 weekly in-person sessions (Milbury et al., 2014). The third study reported that participants practiced 21 minutes per day (Carson et al., 2007).

Satisfaction with the yoga intervention was assessed in three studies (Carson et al., 2007; Danhauer et al., 2008; Milbury et al., 2014) with 92.2% rating yoga as useful or very useful, 88% liked yoga quite a bit or very much, found yoga helpful (scale 0–10; mean = 9.6), and would recommend the program to a friend who has similar concerns (scale 0–10; mean = 10.0).

Outcomes

A variety of quality of life (QOL), mental, physical, and spiritual health outcomes were assessed in the six published nonrandomized studies. Because these studies are typically not adequately powered to detect statistically significant change, with no comparison groups, outcomes are intended to provide preliminary data on the effects of yoga that need further examination in larger fully-powered studies. Effect sizes (indicators of the clinical significance) and qualitative data provide particularly useful information at this initial stage of study (Culos-Reed et al., 2012). Cohen's d is a commonly used effect size and is interpreted as $d \leq 0.2$ is a small, $d \leq 0.5$ medium, and $d \leq 0.8$ a large effect (Cohen, 1992).

Significant improvements in mental health outcomes included overall mental health, anxiety, depression, mood, and negative affect (Danhauer et al., 2008). In addition, large effect sizes were found for anxiety ($d = -0.82$) and relaxation ($d = 0.83$) (Sohl et al., 2012). The latter result was corroborated by qualitative feedback (Danhauer et al., 2008). Further, Milbury and colleagues (2014) found medium effect sizes for depressive symptoms ($d = 0.52$) and small effect sizes for overall mental health and anxiety. Galantino and colleagues (Galantino et al., 2011; Galantino et al., 2012b; Galantino et al., 2012a) qualitatively reported that yoga improved cognition (reduced errors, improved speed). Mood changes and QOL were also qualitatively maintained or improved in this study.

Significant differences in physical health outcomes included improvements in physical QOL, fatigue, invigoration, and most-bothersome symptom (Duncan et al., 2008). Significant improvement in physical QOL was maintained 8 weeks post-intervention (Danhauer et al., 2008). In addition, a significant medium effect was found for improvements in sleep disturbances ($d = 0.60$) (Milbury et al., 2014). Additional outcomes that emerged from qualitative data included increases in self-efficacy, social support, use of yoga in other situations (e.g., when trying to sleep, during medical testing), improved strength and relief of tension, physical and mental invigoration, empowerment, and improved coping (Danhauer et al., 2008; Duncan et al., 2008; Galantino et al., 2012b).

Pediatric studies

Participant demographics

At the time of review, there were only three published single-arm pilot studies in pediatric oncology with a mean of 10 participants in each (Geyer, Lyons, Amazeen, Alishio, & Cooks, 2011; Thygeson, Hooke, Clapsaddle, Robbins, & Moquist, 2010; Wurz, Chamorro-Vina, Guilcher, Schulte, & Culos-Reed, 2014). Parents/caregivers were included as yoga participants in two of the three studies (Geyer et al., 2011; Thygeson et al., 2010). The samples were heterogeneous regarding cancer diagnosis.

Feasibility

All three studies examined feasibility (i.e., recruitment, attrition, adherence, safety, intervention satisfaction) to inform future research. Recruitment rates ranged from 42% to 55%. Two studies reported attrition and adherence rates. Of those who agreed to participate in the single-session study, 90% of the children and 100% of adolescents completed the session and assessments (Thygeson et al., 2010). In the study of a 12-week program, 73% completed assessments, and adherence was 55% (Wurz et al., 2014). Reasons for withdrawals included not liking yoga, returning to school, and being too busy. Reasons for non-adherence included hospitalization/not feeling well and vacation. This study reported that there were no adverse events related to yoga (Wurz et al., 2014).

Outcomes

Patient-reported outcomes for the three pediatric studies were collected from both participants and their parents/caregivers. Feasibility was confirmed in two studies (Thygeson et al., 2010; Wurz et al., 2014). Other pre–post outcomes assessed are summarized in Table 16.1 (see p. 348). Of particular note, two studies used the same measure of pediatric QOL with different subscales showing promising results (Geyer et al., 2011; Wurz et al., 2014). One study documented *clinically* important differences on all QOL factors as rated by children and parents/caregivers (Wurz et al., 2014). In addition, there was some support for the effect of yoga on reducing state anxiety in adolescents; qualitative data further supported this finding, with both children and adolescents reporting that yoga was fun, relaxing, and made them feel calm (Thygeson et al., 2010). Additional statistically significant outcomes included increases in functional mobility, flexibility, number of minutes of physical activity, and metabolic equivalent of task (MET) hours/week (Wurz et al., 2014).

Randomized controlled trials of yoga during cancer treatment

Adult studies

Participant demographics

Eleven randomized studies, reported in 19 separate manuscripts, were reviewed with a total *N* = 796, including *n* = 386 assigned to yoga and *n* = 410 assigned to a control group (Banerjee et al., 2007; Chandwani et al., 2010; Cohen, Warneke, Fouladi, Rodriguez, & Chaoul-Reich, 2004; Danhauer et al., 2009; Dhruva et al., 2012; Kovacic & Kovacic, 2011a; Kovacic & Kovacic, 2011b; Kovacic, Zagoricnik, & Kovacic, 2013; Moadel et al., 2007; Raghavendra et al., 2007; Rao et al., 2009; Rao et al., 2008a; Rao et al., 2008b; Rao et al., 2008c; Vadiraja et al., 2009a; Vadiraja et al., 2009b; Vadiraja et al., 2009c; Taso et al., 2014; Chandwani et al., 2014) (Table 16.2 , see p. 354). Thus, studies were relatively small, averaging 35 participants per study (range 8–84) assigned to yoga. Participants were primarily women who ranged in age fr be distinguished om 18 to 79 years. Five studies that reported race/ethnicity included 51% Caucasian, 25% African American, 18% Latino, 2% Asian, and 4% other or unspecified race participants (Chandwani et al., 2010; Danhauer et al., 2009; Dhruva et al., 2012; Chandwani et al., 2014; Moadel et al., 2007). Most participants were diagnosed with breast cancer (*n* = 767). In studies that specified stage, participants were at the following cancer stages: DCIS (*n* = 28), I (*n* = 170), II (*n* = 243), III (*n* = 186), and IV (*n* = 68). Treatments received while participating included surgery (*n* = 121), chemotherapy (*n* = 239), radiation (*n* = 500), and unspecified medical treatment (*n* = 164).

Intervention characteristics

Six studies used a specific style of yoga, two were based in general yoga traditions, and three did not specify yoga style (see Table 16.3 , p. 360). Almost all included multiple components of yoga, such as a combination of movements/stretching, breathing, and meditation. Two studies had more circumscribed interventions and omitted yoga movements; one focused on breathing, while another featured breathing combined with concentration and an intention to manage uncertainty and fear (Dhruva et al., 2012; Kovacic & Kovacic, 2011a; Kovacic & Kovacic, 2011b; Kovacic et al., 2013).

Dose, where specified, varied from 7 to 18 sessions, lasting 60–90 minutes each session, with 1 session per day to 3 sessions per week, spread over 1–12 weeks. Six interventions were implemented as group classes (Banerjee et al., 2007; Cohen et al., 2004; Danhauer et al., 2009; Kovacic & Kovacic, 2011b; Kovacic & Kovacic, 2011a; Kovacic et al., 2013; Moadel et al., 2007; Taso et al., 2014), while the remaining five studies were implemented primarily in one-on-one sessions (Chandwani et al., 2010; Chandwani et al., 2014; Dhruva et al., 2012; Raghavendra et al., 2007; Rao et al., 2009; Rao et al., 2008a; Rao et al., 2008b; Rao et al., 2008c; Vadiraja et al., 2009a; Vadiraja et al., 2009b; Vadiraja et al., 2009c). Almost all (9 of 11) provided instructions for practicing at home (e.g., audio recordings, printed materials).

Several studies generally indicated that instructors were trained or experienced, but only three studies provided specific information about instructors' training (Chandwani et al., 2010; Chandwani et al., 2014; Danhauer et al., 2009) (see Table 16.3 , p. 360). A single study indicated that the instructor had cancer-specific yoga teacher training (Danhauer et al., 2009).

Feasibility

Three studies reported an average of 20% attrition prior to or immediately after randomization (i.e., prior to beginning yoga classes) (Chandwani et al., 2010; Chandwani et al., 2014; Dhruva et al., 2012). In several studies, attrition was greater among controls than participants assigned to yoga classes (Banerjee et al., 2007; Raghavendra et al., 2007; Rao et al., 2009; Rao et al., 2008a; Rao et al., 2008b; Vadiraja et al., 2009a; Vadiraja et al., 2009b; Vadiraja et al., 2009c), although the reverse was true in one study (Moadel et al., 2007). For the remainder with sufficient information to compare, attrition by group was approximately equal in control versus yoga participants (Cohen et al., 2004; Danhauer et al., 2009; Dhruva et al., 2012; Chandwani et al., 2014). One study reported 100% completion (Taso et al., 2014).

Only two studies reported participants' satisfaction with the yoga interventions; perception of benefits and enjoyment of yoga classes was generally high (Cohen et al., 2004; Danhauer et al., 2009). Although few participants in any trial completed all classes, adherence was high (> 70% completing the majority of classes) in most studies. Three studies reported lower class attendance (39–58% attending the majority of classes) (Cohen et al., 2004; Danhauer et al., 2009; Moadel et al., 2007). Among the few studies reporting rates of home yoga practice, one indicated that all participants completed home practice at least 5 times per week (Kovacic et al., 2013; Kovacic & Kovacic, 2011b; Kovacic & Kovacic, 2011a). In two other studies, more than half of the yoga participants reported home practice on 3 or more days per week (Chandwani et al., 2010; Moadel et al., 2007). The study of pranayama reported a mean of 3.2 hours of home practice per week in the treatment group (Dhruva et al., 2012).

Outcomes

The 11 randomized trials reported on a variety of outcomes including QOL, psychological, spiritual, and physical/medical outcomes. Compared to controls, yoga participants reported significantly better emotional, mental, social, physical, and general QOL and self-reported health (Danhauer et al., 2009; Raghavendra et al., 2007; Dhruva et al., 2012). Yoga participants also demonstrated significant improvements in several measures of mental health, including positive and negative affect, general stress/distress, depression, and anxiety (Banerjee et al., 2007; Danhauer et al., 2009; Kovacic & Kovacic, 2011b; Kovacic & Kovacic, 2011a; Kovacic et al., 2013; Raghavendra et al., 2007; Rao et al., 2009; Rao et al., 2008b; Vadiraja et al., 2009b; Vadiraja et al., 2009a; Vadiraja et al., 2009c; Dhruva et al., 2012). One study reported improvements in yoga participants' self-esteem, and another documented significant improvements in cognitive function (Kovacic & Kovacic, 2011a; Kovacic & Kovacic, 2011b; Kovacic et al., 2013; Vadiraja et al., 2009c). Two studies reported greater spiritual well-being among yoga participants (Danhauer et al., 2009; Moadel et al., 2007).

Yoga participants in several studies reported improved sleep and decreased fatigue (Cohen et al., 2004; Taso et al., 2014; Vadiraja et al., 2009a). Two studies also focused on treatment-related side effects, reporting decreased sequelae-related distress, appetite loss, pain, nausea and vomiting, and toxicity (Raghavendra et al., 2007; Rao et al., 2009; Rao et al., 2008b; Vadiraja et al., 2009a). One study reported favorable post-operative outcomes, including decreased drain retention, earlier suture removal, and shorter hospitalization, among yoga participants (Rao et al., 2008a).

One study also examined an index of stress hormone regulation and found a steeper cortisol slope among yoga participants (Chandwani et al., 2014), which may predict improved survival (Sephton et al., 2000; Cohen et al., 2012). Another RCT examined salivary cortisol and found lower 6:00 am and mean pooled levels in yoga participants compared to controls (Vadiraja et al., 2009b; Vadiraja et al., 2009a; Vadiraja et al., 2009c).

Two other studies investigating physiologic results reported a favorable immune response (i.e., serum immunoglobulins and lymphocytes, TNF-alpha) (Rao et al. 2008a; Rao et al. 2008b) and decreased DNA damage by the end of radiotherapy among yoga participants (Banerjee et al., 2007; Rao et al., 2008b; Rao et al., 2008a).

Pediatric studies

No RCTs of yoga have been conducted with pediatric oncology samples during treatment.

Summary and conclusions, clinical relevance, future research directions

Summary and limitations

Research examining the effects of yoga for adults undergoing treatment for cancer revealed six nonrandomized studies and 11 RCTs. Findings most consistently support the efficacy of yoga to improve mental health outcomes such as distress, mood, and anxiety. Several studies also indicated that yoga improved sleep, fatigue and QOL, though more research is needed to clarify efficacy for different types of QOL (e.g., mental, social, physical, cancer-specific). These effects may be especially noteworthy, given that yoga participants in some studies showed improvements while the waitlist control group worsened on outcomes such as distress and fatigue (Banerjee et al., 2007; Taso et al., 2014). Preliminary support exists for other important outcomes that warrant additional research, including cognitive function, spiritual well-being, treatment side effects, surgical outcomes, and biomarkers of stress and immunity.

Pediatric research is scant but provides initial support for feasibility, safety, and the potential for yoga to improve outcomes among children receiving treatment for cancer. Limitations of pediatric research during cancer treatment include the small size of studies and lack of RCTs. Thus, the effectiveness of yoga for pediatric patients during cancer treatment cannot be determined.

While stronger evidence supports the use of yoga among adults receiving treatment for cancer, findings are constrained by several limitations. Studies have almost exclusively used self-reported measures. The vast majority of participants have been females with breast cancer, though the type of cancer was more varied in nonrandomized studies. Few trials of yoga have included people with Stage IV cancer, despite the fact that yoga may be gentle enough for individuals with more advanced disease and potentially affect important outcomes (e.g., distress, QOL). Variability in study protocols also limits generalizability of the findings. Most studies combined several elements of yoga (e.g., movement, breathing, meditation), and intervention delivery has varied (e.g., group vs. individual; instructor-delivered vs. home practice). Studies have also used a wide range of doses and achieved differing rates of retention and adherence. Moreover, despite two notable exceptions (Chandwani et al., 2014; Kovacic & Kovacic, 2011b; Kovacic & Kovacic, 2011a; Kovacic et al., 2013), studies rarely included an active control group. The “active ingredients” of yoga interventions and the amount of yoga practice needed to yield effects therefore remains unknown and cannot be distinguished from nonspecific, but potentially effective, elements of the interventions (e.g., social support, attention).

Other components of study design may also affect outcomes. For example, participation and attrition rates may be influenced by recruitment methods/criteria. Studies that sample from people already enrolled in yoga classes are likely to have high rates of enrollment and retention, although results may lack generalizability. In addition, yoga teachers in most published research have not been specifically trained in teaching yoga to people with cancer. Details of teachers’ training and experience are rarely provided, although these factors may influence participants' adherence and efficacy of interventions. Moreover, studies rarely report on treatment fidelity efforts, compounding the difficulty of interpreting and applying results.

Despite these limitations, there is sufficient evidence for a number of outcomes to recommend yoga to adult patients undergoing cancer treatment, particularly women with breast cancer (Greenlee et al., 2014). In some cases the improvements noted were clinically significant. Further, no studies reported any adverse events of practicing yoga during treatment.

Future directions

While studies of yoga for cancer patients have proliferated and generally improved in quality in recent years, advancing the science in this field still requires more rigorous methodology. A recent article offers excellent guidelines for systematically developing yoga interventions for use in RCTs in the following eight domains: style of yoga, dose of yoga, components of the yoga intervention, specific class sequences, addressing modifications, selection of instructors, home practice, and measurement of intervention fidelity over time (Sherman, 2012). Yoga researchers would be well served to develop criteria for interventions and methodology similar to acupuncture research (i.e., STRICTA criteria) (MacPherson et al., 2010). In addition to these important topics, we offer several suggestions for improving the quality of studies in the following areas: (1) sample selection; (2) recruitment, retention, and adherence; (3) research design; and (4) inclusion of objective and novel measures. We conclude with the suggestion to examine yoga as more than simply a combination of movement, meditation, and relaxation, but rather as a broader lifestyle intervention.

Several suggestions regarding sample selection come from this review of research on yoga targeting people with cancer undergoing treatment. First, more studies in pediatric oncology are clearly needed. The feasibility data in pediatric and adolescent oncology patients suggests that further well-designed research targeting younger age groups would be fruitful. Second, it will be useful to consider inclusion of a close family member or caregiver in yoga interventions to address stress, health, and QOL issues in those who are supporting and caring for people with cancer (Milbury et al., 2014). From a pragmatic standpoint, it may be easier to recruit and retain cancer patients when caregivers are included in the intervention. Finally, future work should consider recruiting participants in a more targeted way. Although offering yoga to all with the intention of buffering side effects of treatments may be useful, a better understanding of the effects of yoga for treating specific symptoms (e.g., fatigue, sleep disturbances, cognitive impairment) or offering yoga to especially vulnerable groups (e.g., patients with a history of depression) may help reach those most in need and take into account limited funding available for this type of program.

Recruitment, retention, and adherence are challenging, with cited barriers including traveling distance, change in interest, scheduling difficulties, increase or decrease in symptoms, and health issues (Carson et al., 2007; Danhauer et al., 2008; Duncan et al., 2008; Milbury et al., 2014; Sohl et al., 2012). Studies suggest that health issues and symptoms may be both motivators *and* barriers to participation. When developing studies of yoga for people with cancer during treatment, it is important to build in flexibility of design and scheduling in order to accommodate frequently changing patient schedules and ability to participate based on competing demands and treatment-related symptoms. For example, interventions could be offered with inpatient, outpatient, and home-based alternatives (Wurz et al., 2014). Also, offering such classes at home through use of remote technologies such as multi-point videoconferencing could allow participants to take cancer-specific yoga classes with others in treatment and a teacher while at home and at a convenient time. Finally, carefully documenting adherence to in-person and home practice is essential for understanding the dose and potential efficacy of yoga interventions. In addition, the prior suggestion to include social support in the study intervention may also positively influence adherence to yoga (Carson et al., 2007; Galantino et al., 2012b; Milbury et al., 2014; Sohl et al., 2012).

The ideal research design from the biomedical perspective is a randomized, double blind, placebo-controlled trial. It is, of course, challenging to conduct double-blinded trials with mind–body/behavioral interventions. However, with the use of active control groups engaged in an activity that has face validity, participants can at least be blinded to whether they are in the “real intervention” or “active control” group. For example, in the consent form for a study of the effects of tai chi for fibromyalgia, participants were told that they were in a study examining the effects of two different kinds of exercise (Wang et al., 2010). They were then randomized to the tai chi group or an active exercise control group so that all were blinded to the true aim of the study (i.e., to compare tai chi to exercise). The inclusion of the active control will often necessitate having a third arm in the trial of usual care (Chandwani et al., 2014). Moreover, by not including an active control group, studies cannot conclude that the findings are specifically benefits of yoga because non-specific aspects of yoga (e.g., attention, social support) may explain some benefit. Some evidence suggests that the more patients engage in yoga, the better the outcomes (Moadel et al., 2007). Thus it is also important to understand the ideal “dose” of yoga needed to experience benefits and the minimum amount of in-person instruction needed for patients to practice yoga safely on their own.

In addition to continuing to measure self-reported outcomes included in the majority of studies thus far, future research examining the efficacy of yoga during cancer treatment should expand on the growing use of objective physiological/biological measures (e.g., cortisol, pro-inflammatory cytokines, heart rate variability) and incorporate genomic and epigenetic measures. Cognitive function is also an important and relatively unexplored potential benefit of yoga interventions in cancer patients, and objective behavioral and neuroimaging measures would be valuable. Additional outcomes that emerged from qualitative data included increases in self-efficacy, social support, use of yoga in other situations (e.g., when trying to sleep, during medical testing), improved strength, relief of tension, physical and mental invigoration, empowerment, and improved coping ability (Danhauer et al., 2008; Duncan et al., 2008; Galantino et al., 2012b). Such constructs may be useful to incorporate into future studies. Finally, virtually no research has examined potential savings in medical costs and healthcare utilization that may result from yoga interventions. Including such bottom-line outcomes would be useful to support the integration of yoga into clinical settings (Kligler et al., 2011).

In conclusion, we have seen that different yoga interventions lead to improvements in various aspects of QOL, physical function, and, in some cases, biological function. However, the potential for yoga therapy to achieve the best clinical outcomes for those with cancer may not have been maximized yet. Yoga theoretically goes beyond the movements, breathing, and meditation typically included in studies to date and may influence healthful living as a whole (i.e., what we eat, whether we exercise, philosophical discussions on life purpose). Little research has examined whether holistic lifestyle interventions help to control cancer outcomes, yet initial studies suggest that this approach shows great potential for integration with conventional cancer treatments (Andersen et al., 2008; Ornish et al., 2005). Given that cancer survivors with normal BMI, who do not use tobacco, are physically active, eat primarily a plant-based diet, avoid harmful use of alcohol, and are not depressed tend to live longer after a diagnosis of cancer (Satin et al., 2009; Giese-Davis et al., 2011; Thomson et al., 2014; Vergnaud et al., 2013; WHO, 2015) future research could examine whether a comprehensive yoga approach facilitates these outcomes, thereby helping people manage side effects of conventional cancer treatments, improving clinical outcomes, and perhaps extending and enhancing survival.

Table 16.1 Nonrandomized studies of yoga during cancer treatment					
Author:	**Design/sample:**	**Cancer type and treatment:**	**Adherence:**	**Outcome measures:**	**Results:**
Last name Year Country	**– Design – *N* = X (*n* = X by sex) – Age: mean (SD; range) – Race/ethnicity**	**– Cancer type – Stage – Treatment (s) received during the study**	**– Completing protocol (# or %) – Class adherence (% or # of classes)**	**– Timing of assessment – Primary measures**	********p* < .0 ***p* < .0 **p* < .05**
Adult studies					
Carson et al., 2007 USA	– Single-arm pilot – *N* = 21 (all female) – Mean age = 59 (SD = NR; 44–75) – Caucasian (*n* = 11), African American (*n* = 2)	– Breast (*n* = 13) – Stage IV (*n* = 13) – Chemotherapy (*n* = 7)	– *N* = 13 completed protocol (3 withdrew before intervention, 5 after starting intervention) – Attended average 7 of 8 sessions (87.5%; range 5–8)	– Baseline (daily for two weeks prior to intervention), postintervention (weeks 6–8) – Daily visual analog scales of pain, fatigue, distress, invigoration, acceptance, relaxation – Satisfaction (0–10 ratings) – Qualitative responses	– Main ef change invigora accepta – Lagged one day pain,* fa invigora accepta relaxati – Satisfac helpfuln Likeliho recomm – Qualitat useful, to life, s compas support
Danhauer et al., 2008 USA	– Single-arm pilot; – *N* = 51 (all female) – Mean age = 58.9 (SD = 11.2; 34–82) – *n* = 45 Caucasian, – *n* = 5 African American, – *n* = 1 Asian/Pacific Islander	– Ovarian (*n* = 37); breast (*n* = 14) – DCIS and Stages I-IV – Chemotherapy (*n* = 29); radiation (*n* = 5)	– *n* = 43 completed postintervention follow-up (week 10); *n* = 38 completed final follow-up (week 18) – Mean # of classes attended: 5.9 of 10 (SD = 3.2) – 51% attended ≥ 7 of 10 classes, 26% attended 0–2 classes	– Baseline, postintervention (week 10), final follow-up (week 18) – QOL (SF-12 MCS/PCS), depressive symptoms (CES-D), affect (PANAS), anxiety (STAI), cancer-specific QOL (FACT-G), spirituality (FACIT-Sp), fatigue (FACT-Fatigue), satisfaction, qualitative responses	– Week 1 mental depress sympto negativ overall physica fatigue* – 88% lik “quite a much” – Qualitat experie and em benefits
Duncan et al., 2008 Canada	– Single-arm pilot; – *N* = 24 (*n* = 23 female, *n* = 1 male) – Mean age = 49 (range NR)	– Breast (*n* = 10), gynecologic (*n* = 4),	– 100% provided postintervention (week 10) data – NR	– Baseline, weeks 5 and 10 of the program, and 6 weeks after the program	– Week 1 bothers sympto G,*** FA POMS-S

	– *n* = 20 Caucasian	lymphoma (*n* = 3); other (*n* = 7) – NR – *n* = 16 undergoing treatment (type NR) at baseline		– Most bothersome symptom (Measure Your Medical Outcome Profile 2 instrument), FACT-G, FACIT-Sp, POMS-SF – Qualitative responses provided by *n* = 6 selected participants	– Qualitat additior (physica relaxati useful, intro to social s
Galantino et al., 2012 USA	– Case series; – *N* = 4 (all female) – Mean age = 54.8 (SD = NR; 44–65) – *n* = 4 Caucasian	– Breast (*n* = 4); – Stage II Chemotherapy (*n* = 4); radiation (*n* = 2)	– NR – All four women participated in 60–70% of the classes. Two of the four women adhered to the home yoga program 80% of the time, while the other two reported less than 50% of the time	– Baseline, 6, and 12 weeks during chemotherapy, and at 1 and 3 months after study conclusion – CogState, Perceived Cognition Questionnaire, FACT-B, POMS, Sit and Reach, Functional Reach, qualitative responses	– No quar findings – Qualitat appeare cognitic specific errors a speed. over ba change also maintai
Kumar & Balkrishna, 2009 India	– *N* = 8 (all male) – Mean age NR; range 18–55 – NR	– CLL (*n* = 8) – Stage NR – Treatment NR	– NR	– NR	– Increase express NM BX, practitic apparer nonranc control NR on t
Milbury et al., 2014 USA	– Single-arm pilot; – *N* = 10 patients (*n* = 5 female, *n* = 5 male); – *N* = 10 caregivers (*n* = 9 female, *n* = 1 male) – Patient mean age = 71.22 (SD = 6.16; 61–82); caregiver mean age = 68.77 (SD = 5.99; 61–78) – Patients: *n* = 8 Caucasian, *n* = 1 Hispanic; caregivers: *n* = 8 Caucasian, *n* = 1 Hispanic	– Lung (*n* = 10) – Stages I and III – Radiation (*n* = 10); chemotherapy (*n* = 7)	– 10/14 dyads (71%) completed program – Dyads completed a mean of 12 of 18 classes (SD = 2.91; range: 6–15); individual home practice M = 2.63 times (SD = 2.62; range 0–9)	– All completed by patients and caregivers. Distress (CES-D), anxiety dimension (BSI-18), sleep disturbance (PSQI), fatigue (BFI), health-related QOL (SF-36 PCS, MCS), spiritual well-being (FACIT-Sp), Finding Meaning in Cancer scale; satisfaction	– Patients well-bei effect s disturba depress sympto effect s anxiety – Majority rated pr useful c

Sohl et al., 2012 USA	– Single-arm pilot – *N* = 7 (all female) – Mean age = 61.7 (SD = 6.7; range NR) – *n* = 7 Caucasian; *n* = 1 Hispanic	– Ovarian (*n* = 7) – NR Chemotherapy (*n* = 7)	– First session *n* = 7 (100%); second session *n* = 4 (57%); third session *n* = 3 (43%)	– VAS for anxiety and relaxation assessed immediately pre- and post-session – Qualitative responses	– Large e immedi anxiety relaxati – Qualitat practice relaxati breathi daily ac prayers
Pediatric studies					
Geyer et al., 2011 USA	– Single-arm pilot – *N* = 6 (*n* = 5 female, n = 1 male); *N* = 4 caregivers participated – Mean age: Child NR (5–19); parents/caregivers NR – NR	– AML (*n* = 1), ALL (*n* = 3), Ewing's sarcoma (*n* = 1), Fanconi's anemia (*n* = 1) NR Varied inpatient treatment (some post-BMT)	– NR	– Baseline, postintervention (weeks 5–8) – Child QOL: physical, emotional, social, and school function (PedsQL4.0 completed by child and caregiver)	– Feasibil suggest directio – Child ra physica
Thygeson et al., 2010 USA	– Single-arm pilot – *N* = 11 children (*n* = 4 female, *n* = 7 male); *N* = 5 adolescents (*n* = 2 female, *n* = 3 male); *N* = 33 parents/caregivers (*n* = 23 female, *n* = 10 male) – Mean age: Children: 8.6 (SD = 1.8; 7–12); adolescents: 15.4 (SD = 1.8; 13–18); caregivers: 37.4 (SD = 7.3) – Children: 73% Caucasian; adolescents: 80% Caucasian; parents: 70% Caucasian	– ALL (*n* = 6) – AML (*n* = 1); solid tumor (*n* = 4); CNS tumor (*n* = 4); sickle cell disease (*n* = 1) – NR – NR (all inpatient)	– 90% children, 100% adolescents, 96% parents completed yoga and measurements	– Baseline, immediately after the yoga session – Feasibility – State anxiety (STAI) – Qualitative	– Feasibil – State ar childrer at base adolesc parents – Qualitat childrer benefits relaxing good; a calm, re helpful care/str manage caregiv and mo stress r and cer care, bo child
Wurz et al., 2014 Canada	– Single-arm pilot – *N* = 8 (*n* = 4 female, *n* = 4 male) – Mean age = 11.9 (SD = 4.3; 5–17) – NR	– Osteosarcoma (*n* = 1), CNS (*n* = 2), ALL (*n* = 2), CML (*n* = 1), lymphoma (*n* = 1), multiple cancers (*n* = 1) – Chemotherapy only (*n* = 4), multiple	– 73% (8/11) completed the program – Attendance for completers was 55% (range 42–88%)	– Baseline, postintervention (weeks 12–14) –Feasibility – Child QOL: physical, emotional, social, and school function (PedsQL 4.0 completed by child and caregiver)	– Feasibil – Child ra functior ratings physica school* QOL fac clinicall differen by child parents – Functior flexibilit

	treatments (*n* = 2), posttreatment (*n* = 2)	– Physical fitness: functional mobility, flexibility, range of motion – Physical activity levels (Leisure Score Index - GLTEQ)	– Numbe of phys MET ho

ALL: acute lymphocytic leukemia; AML: acute myeloid leukemia; BFI: Brief Fatigue Inventory; BMT: bone marrow transplant; BSI-18: Brief Symptom Inventory-18; CES-D: Centers for Epidemiological Studies Depression; CLL: chronic lymphocytic leukemia; CML: chronic myeloid leukemia; CNS: central nervous system; FACT-Fatigue: Functional Assessment of Cancer Therapy – Fatigue; FACT-G: Functional Assessment of Cancer Therapy – General; FACIT-Sp: Functional Assessment of Chronic Illness Therapy – Spiritual; GLTEQ: Godin Leisure Time Exercise Questionnaire; MCS: Mental Component Summary; NR: not reported; NS: not significant; PANAS: Positive and Negative Affect Scale; PCS: Physical Component Summary; POMS: Profile of Mood States; POMS-SF: POMS-Short-Form; PSQI: Pittsburgh Sleep Quality Index; QOL: quality of life; RCT: randomized controlled trial; SD: standard deviation; SF-12: Medical Outcomes Study 12-item short-form; SF-36: Medical Outcomes Study 36-item short-form; STAI: State Trait Anxiety Inventory; VAS: Visual Analog Scale.

Table 16.2 Randomized controlled trials of yoga during cancer treatment					
Author:	**Sample:**	**Cancer type and treatment:**	**Adherence:**	**Outcome measures:**	**Results:**
Last name – **Year** – **Country**	**– Design** **– *N* = X (*n* = X by sex)** **– Age: mean (SD; range)** **– Race/ethnicity**	**– Cancer type** **– Stage** **– Treatment (s) received during the study**	**– Completing protocol (# or %)** **– Class adherence (% or # of classes)**	**– Timing of assessment** **– Primary measures**	– ********p* < .0** – *******p* < .01**
Adult studies					
Banerjee et al., 2007 India	– RCT: yoga versus supportive counseling – *N* = 68 (100% female; *n* = 35 yoga, *n* = 33 control) – Age: 44 (1.3; range NR) – NR	– Breast (*N* = 58) – Stages II–III – Radiation (*N* = 58)	– *n* = 35 yoga – *n* = 23 control – NR	– Pre- and post-radiation – Anxiety and depression (HADS), stress (PSS), DNA damage (alkaline single-cell gel electrophoresis)	– Anxiety,** depression stress,*** damage.** and PSS in in control decrease i group
Chandwani et al., 2010 US	– RCT: yoga versus waitlist control – *N* = 61 (100% female; *n* = 30 yoga, *n* = 31 control) – Age: yoga: 51.39 (7.97; 37.1–67.6); control: 54.02 (9.96; 31.8–67.9) – *n* = 3 African American; *n* = 47 Caucasian; – *n* = 5 Hispanic; *n* = 1 Asian/Pacific Islander; – *n* = 3 Other	– Breast (*N* = 61) – Stages 0–III – Radiation (*N* = 61)	– *N* = 81 enrolled; *n* = 10 withdrew prior to randomization ; *n* = 10 withdrew prior to radiation – *n* at T1, T2, T3, T4: yoga = 30, 27, 26, 27; control = 31, 31, 27, 29 – 15 (50%) completed all 12 classes – 8 (28%) attended 11 – 1 (3%) attended 10 – 1 each attended 2, 3, 4, 5, 7, 8 classes – 8 (28%) practiced daily, 12 (40%) > 2 times per week, 8 (28%) 2 times per week, 1 (3%) no home practice	– Pre-RT/yoga (T1) and 1 week (T2), 1 month (T3) and 3 months (T4) after last RT session – QOL (SF-36), fatigue (BFI), sleep (PSQI), depression (CES-D), anxiety (STATE), intrusion and avoidance (IES), benefit finding (BFS)	– Sleep, dep fatigue, ar were all N reported b physical Q general he and physic function* t control at – At T3, intru – At T4, ben finding** – Intrusive t at T3 were positively associated at T4
Chandwani	– RCT: yoga vs.	– Breast (*N* =	– *N* = 191	– pre-RT/yoga	– Depression

et al., 2014 US	active control (stretch) vs. waitlist control – N = 163 (100% female; n = 53 yoga; 56 stretch; 54 waitlist) – Age: yoga: 52.38 (1.35; 26–77); stretch: 51.14 (1.32; 25–79); waitlist: 52.11 (1.34; 30–69) – n = 25 African American; n = 97 Caucasian; – n = 17 Hispanic; n = 7 Asian/Pacific Islander; – n = 4 Other	163) – Stages 0–III – Radiation (N = 163)	consented; n = 13 withdrew prior to randomization; n = 15 withdrew after randomization – n at T1, T2, T3, T4, T5: yoga: 53, 49, 39, 41, 43; stretch: 56, 52, 44, 41, 43; waitlist: 54, 48, 43, 42, 46 – 87% yoga and 85% stretch attended > = 12 of 18 classes – n = 3 per group attended < 50% classes	(T1) and 1 week (T2), 1 month (T3), 3 months (T4) and 6 months (T5) after last RT session; QOL (SF-36), fatigue (BFI), sleep (PSQI), depression (CES-D) – salivary cortisol	sleep NS a points; at T fatigue* w and stretc lower thar but not dif from each – at T3, yoga physical Q than contr physical fu and gener health** b than stretc – at T4, yoga physical Q better thar yoga phys function* a general he better thar and contro – at T5, yoga physical fu better thar – cortisol slo steeper in T2 (versus and contro at T3 (vers control*)
Cohen et al., 2004 USA	– RCT: yoga versus waitlist control – N = 39 (n = 12 female; n = 20 yoga; n = 19 control) – Age: 51 (SD and range NR) – NR	– Lymphoma (N = 39) – Stages I–IV – Chemotherapy (n = 24)	– n = 19 in each group (1 yoga patient dropped out before beginning classes) – n = 6 (32%) attended all 7 sessions; 5 (26%) attended 5–6; 6 (32%) attended 2–3; 2 (10%) attended only 1 session; 19 (84%) of yoga group and 14 (74%) of controls completed at least 1 of 3 follow-up assessments	– 1–3 weeks prior to start of yoga classes; then 1 week, 1 month and 3 months after last session – Distress (IES); anxiety (STATE); depression (CES-D); fatigue (BFI); sleep disturbance (PSQI)	– On averag participant each elem (breathing mindfulnes movement beneficial 5 point sca – TY group r better ove sleep,** sl quality,* s latency,** duration,* sleep med use*
Danhauer et al, 2009 USA	– RCT: yoga versus waitlist – N = 44 (100% female; n = 22	– Breast (N = 44) – Stages 0–IV	– Mean # yoga classes attended = 5.7; n = 11	– Baseline (week 0) and week 10 (within 1 week of last class)	– Group effe mental functioning depression

	per group) – Age: yoga: 54.3 (9.6; 38–76); control: 57.2 (10.2; 41–79) – *n* = 39 Caucasian; *n* = 3 African American; *n* = 2 Asian/Pacific Islander	– Chemotherapy (*n* = 11); radiation (*n* = 9)	attended ≤ 7 of 10 classes, *n* = 6 attended 3–6, *n* = 5 attended ≤ 2 – Complete data analyzed from 13 yoga and 14 control (9 yoga and 7 control did not return questionnaire, 1 control dropped out)	– Perceived health and functioning (SF-12), QOL (FACT-B), fatigue (FACT-Fatigue), spiritual well-being (FACIT-Spirituality), depression (CES-D), sleep (PSQI), affect (PANAS)	positive af spiritual w (peace/me – Baseline x interactior negative a emotional being*; sig relationshi between # and physic functioning cancer QO physical w being,** fu well-being – 92% liked quite a bit much. Sca mean ratir teacher co 3.8; teach class enjoy liked class classes he will contin
Dhruva et al., 2012 USA	– RCT: yoga versus waitlist who got program after first cycle of chemotherapy – *N* = 23 (*n* = 2 males, both in yoga group) – Age: yoga: 52.4 (14.6; range NR); control: 56.0 (11.9; range NR) – *n* = 10 Caucasian	– Breast (*n* = 8); Other (*n* = 8) – Nonmetastatic and metastatic – Chemotherapy (*n* = 23)	– 3 yoga, 2 control withdrew immediately after randomization – *n* = 9 per group completed treatment; *n* = 8 per group analyzed – 100% class attendance in control, 97% in yoga group – Average home practice 2.4h/week control, 3.2h/week yoga	– Baseline, midpoint (after cycle 1), study end – Fatigue (revised PFS), sleep disturbance (GSDS), anxiety and depression (HADS), stress (PSS), QOL (SF-12)	– Amount of was assoc decreased disturbanc decreased and impro mental QC – No statisti analyses p for the bet group effe
Kovacic et al., 2013; Kovacic & Kovacic 2011a, 2011b Slovenia	– RCT: yoga versus standard physiotherapy (SP) – *n* = 16 per group (100% female) – NR – NR	– Breast (*N* = 32) – Stages I–II – Surgery, followed by chemotherapy and radiation (*N* = 32)	– NR – All participants completed home practice 5–7 times per week	– Baseline (postsurgery), 1 week after attendance, 4 weeks after attendance – Distress (GHQ-12; RSCL-psychological subscale); perceived stress (PSS);	– Distress (C RSCL),** a and self-es T2 and T3; perceived at T3 (not measured

				self-esteem (RSE); anxiety (STAI)	
Moadel et al., 2007 USA	– RCT: yoga versus usual care – N = 164 (n = 108 yoga, n = 56 control) – Age: 54.82 (9.95; 28–75) – n = 54 African American; n = 40 Hispanic; n = 29 Caucasian; n = 5 Other	– Breast (N = 164) – Stages I–IV – 48% received medical treatment (e.g., 27% chemotherapy and 30% antiestrogen therapy at baseline)	– n = 16 yoga, 8 control lost to follow-up; n = 5 yoga, 3 control refused further participation; n = 3 yoga, 1 control withdrew due to change in health status (attrition 22% yoga, 21% control) – Analyzed data from n = 84 yoga with baseline and 3 mo data (n = 24 with baseline data only), n = 44 control – 32% of yoga participants with baseline and 3 mo data attended 0 classes, 39% attended > 6 of 12 classes; 19% reported 0 home practice, 51% few times/week	– Baseline, 1 month, 3 month, 6 month – QOL (FACT); fatigue (FACIT-Fatigue); spiritual and existential well-being (FACIT-Sp); distressed mood (POMS)	– Social well decreased control gro compared group from to 3 mo* – Within yog those atte classes ha fatigue tha and 0 clas better phy well-being 6* and tha classes, ar distress th classes
Raghavendra et al., 2007; Rao et al., 2009, 2008a, 2008b, 2008c India	– RCT: yoga versus supportive therapy/coping preparation (not matched on exposure time) – N = 98 (100% female; 45 yoga, 53 supportive therapy) – Age: 49.2 (9.6; range NR) – NR	– Breast (N = 98) – Stages II–III – Surgery followed by standard protocol of radiation and chemotherapy	– n = 18 yoga, 20 control completed; 12 yoga, 17 controls discontinued postsurgery + 15 yoga, 13 controls did not receive the standard regimen;	– Presurgery, postsurgery, during and after RT and chemo – Anxiety (STAI); treatment-related symptoms (study-specific measure); nausea and vomiting (MANE); depression (BDI); QOL (FLIC); post-operative	– Lower stat anxiety* a symptom at all time yoga vs. c completer intention-t analysis sh lower anxi at postsur yoga comp yoga reduc chemo nau frequency severity,** severity,* during che yoga fewe

				outcomes; immune biomarkers (serum and plasma)	drain reten suture rem hospital st postsurger difference complicati alpha or IF gamma; yo group TNF significant decreased control gro alpha sign increased*
Taso et al., 2014 Taiwan	– RCT: yoga versus standard care – N = 60 (30 per group; 100% women) – Age: 49.27 (10.23; range NR) – NR	– Breast (N = 60) – Stages I–III – Chemotherapy (N = 60)	– 100% completion; 80% adherence n = 3 attended 13–14 of 16 classes; – n = 13 attended all 16 classes	– Pre-intervention, 4 weeks (mid-), 8 weeks (post-) and 4- week follow-up – Depression and anxiety (POMS), fatigue (BFI-Taiwan)	– Time by gr interaction anxiety an depression NS; fatigue effect of fa daily life;** experimen main effec fatigue*** fatigue eff daily life** week post fatigue an effect on d life*** incr within the group) – Among ind with low fa interventio reduced fa and its effe daily life a test* and f
Vadiraja et al., 2009a, 2009b, 2009c India	– RCT: yoga versus supportive counseling (not matched on exposure time) – N = 88 (44 per group; 100% female) – Age: yoga: 46.7 (9.3, range NR); control: 48.5 (10.2, range NR) – NR	– Breast (N = 88) – Stages I–III – Adjuvant radiation (n = 75)	– n = 2 yoga dropouts; 11 control dropouts – 30% attended 10–20 of 36 sessions; 57% attended 20–25; 14% attended > 25 of 36 sessions	– Pre- and post-RT – Anxiety and depression (HADS); perceived stress (PSS); distress, physical and functional status and global QOL (RSCL); treatment-related symptoms (EORTC QOL C30); affect (PANAS); diurnal salivary cortisol	– Anxiety,** depression perceived psycholog distress;** fatigue,** insomnia,* appetite lo pain,* nausea/vo positive af negative a emotional* cognitive* 6 am* and pooled diu cortisol*

Pediatric studies
NONE

BFI: Brief Fatigue Inventory; BFS: Benefit Finding Scale; CES-D: Center for Epidemiologic Studies Depression Scale; EORTC: European Organization for the Research and Treatment of Cancer; FLIC: Functional Living Index of Cancer; GHQ: General Health Questionnaire; GSDS: General Sleep Disturbance Scale; HADS: Hospital Anxiety and Depression Scale; HADS-A: HADS-Anxiety; HADS-D: HADS Depression; IES: Impact of Events Scale; MANE: Morrow Assessment of Nausea and Emesis Questionnaire; NR: not reported; NS: not significant; PANAS: Positive and Negative Affect Scale; PFS: Piper Fatigue Scale; PSQI: Pittsburgh Sleep Quality Index; RCT: randomized controlled trial; RSCL: Rotterdam Symptom Checklist; RSE: Rosenberg Self-Esteem Scale; RT: radiation therapy; SF-12: Medical Outcomes Study 12-item short-form survey; SF-36: Medical Outcomes Study 36-item short-form survey; STATE: Speilberger State Anxiety Inventory State Portion; TY: Tibetan yoga.

Table 16.3 Yoga protocol details

Author, year	– Name/style of yoga – Intervention components	– Duration, frequency – Delivery – Home practice	– Instructor qualifications – Cancer-specific yoga training	– Specific class sequence – Modifications – Progression – Treatment fidelity
Adult studies				
Banerjee et al., 2007	– VYASA – Movements, pranayama, meditation, yoga nidra relaxation, chanting	– 90-minute sessions (frequency NR) during 6 weeks of radiation therapy – NR – Audio recordings provided for home practice	– NR – NR	– NR – NR – NR – NR
Carson et al., 2007	– Broad spectrum of traditional yogic techniques – Movements, pranayama, meditation techniques, study of pertinent topics, and group discussions	– Eight weekly 120-minute sessions – Group classes – 10 minutes of home practice daily (with CDs or audiotapes, illustrated handbooks)	– Jointly led by a yoga teacher registered with the national Yoga Alliance and a clinical health psychologist – Extensive experience in teaching yoga to medical patients	– Manual was developed with detailed session guidelines – Instructions were modified to address individual patient needs – NR – All sessions were videotaped and reviewed in weekly team meetings
Chandwani et al., 2010	– VYASA – Movements, pranayama, savasana, meditation, moral injunctions for a healthy lifestyle (yama and niyama)	– 60-minute sessions, up to 2 times per week for 6 weeks (maximum of 12) – Group classes (most were implemented individually due to scheduling) – Given audio CD and printed manual with photos and instructions to encouraged daily home practice	– VYASA-trained teachers – NR	– Provided in publication – NR – NR – NR
Chandwani et al., 2014	– VYASA – Movements, breathing, savasana, meditation	– 60-minute sessions, up to	– VYASA-trained teachers – NR	– Provided in publication – NR

		3 times per week for 6 weeks – Group classes (most were implemented individually due to scheduling) – Given audio CD and printed manual with photos and instructions to encourage home practice		– NR – NR
Cohen et al., 2004	– Tibetan yoga (Tsa lung and Trul khor) – Breathing practice, visualization, meditation, movements from Tsa lung, and preliminary set of movements from Trul khor (“simple motions done with specific breathing patterns”)	– 1 session per week for 7 weeks – Group classes – Encouraged daily home practice – Provided with printed materials after each class and audiotape after final session	– Experienced TY instructor – NR	– NR – NR – NR – NR
Danhauer et al., 2008	– Restorative yoga – Movements, breathing practice, deep relaxation, guiding principle of ahimsa (non-violence)	– 10 weekly 75-minute sessions – Group classes – NR	– Registered with National Yoga Alliance – Integral Yoga Therapy in Cancer and Chronic Illness	– Sequence provided – Modifications made as needed – NR – NR
Danhauer et al., 2009	– Restorative yoga – Movements, breathing practice, deep relaxation, guiding principle of ahimsa (non-violence)	– 10 weekly 75-minute sessions – Group classes – NR	– Registered with National Yoga Alliance – Integral Yoga Therapy in Cancer and Chronic Illness	– Sequence provided – Modifications made as needed – NR – NR
Dhruva et al., 2012	– NR – Breathing practices (breath observation, ujjayi breathing, kapalabhati, nadi shodhana)	– 4 60-minute weekly sessions – Group classes (most sessions had 1–2 participants) – Home practice recommended 2 times per day (total 20–30 minutes per day) throughout 2 chemotherapy cycles	– Yoga instructors with training in therapeutic yoga – Experience teaching yoga to people with cancer	– NR – NR – NR – Assessed adherence using instructor log-book and random session recordings
Duncan et	– Iyengar	– 4 weekly 90-	– NR	– Provided in

al., 2008	– NR	minute sessions – Group classes – NR	– NR	publication – NR – NR – NR
Galantino et al., 2012	– Iyengar-inspired – Precise postures, breathing practices, meditation	– Twice weekly 70-minute sessions for 6 weeks and weekly sessions for next 6 weeks (12 weeks total) – Group classes – Abbreviated home practice to be practiced three times per week for 15 minutes	– Iyengar qualified – NR	– Provided in publication – Used props to adapt poses – Consistent across sessions – NR
Kovacic et al., 2013; Kovacic & Kovacic 2011a, 2011b	– Yoga in Daily Life (YIDL) – Breathing practices, relaxation, meditation	– Daily 45-minute sessions for 1 week postsurgery – Group sessions – Daily practice for 3 weeks at home (with audio recording) following in-person intervention	– 7 years' experience with YIDL – 3 years' experience with oncology patients	– Provided in publication – NR – NR – NR
Kumar & Balkrishna, 2009	– Swami Ramdev Yog – Breathing practices	– 7 sequences of Swami Ramdev Yog – NR – NR	– NR – NR	– NR
Milbury et al., 2014	– Tibetan Yoga (Tsa lung) – Deep breathing awareness with visualization, breathing practices, mindfulness and focused attention through guided meditation, Tsa lung movements, brief compassion-based meditation	– 2–3 weekly sessions (45–60 minutes) over 5–6 weeks – Individual sessions per dyad – Printed materials and a CD for home practice on days not meeting with instructor	– NR – NR	– NR – Sessions 1–4 focused on gradually introducing the various techniques, sessions 5–15 focused on refining and practicing the techniques
Moadel et al., 2007	– Hatha – Movements, breathing practice, meditation; all poses seated or reclined with props	– Weekly 90-minute sessions for 12 weeks – Group classes	– NR – NR	– NR

Raghavendra et al., 2007; Rao et al., 2009, 2008a, 2008b, 2008c	– VYASA – Movements, breathing practice, meditation, relaxation with imagery, chanting	– 4 sessions pre- and postsurgery; 3 sessions per week for 6 weeks of radiation therapy; 1 session every 10 days during chemotherapy – Implemented individually – Audio recordings for home practice	– 2 instructors, one was a physician in naturopathy and trained in yoga and the other a trained and certified therapist in yoga from the yoga institute – NR	– NR
Sohl et al., 2012	– Key skills from multiple traditions (i.e., informed by training in Integral Yoga, Urban Zen Integrative Therapy) – Seated movements, breathing practice/relaxation, meditation, theme of self-compassion	– 3 individual 15-minute sessions – Implemented individually during chemotherapy infusions – Printed materials provided for home practice	– NR – Integral Yoga Therapy in Cancer and Chronic Illness	– NR – All practices were consistent across patients; however, the gentle movements were adapted based on individual ability – NR – NR
Taso et al., 2014	– Anusara – Movements, breathing practice, meditation	– 60-minute sessions, 2 times per week over 8 weeks – NR – NR	– "Experienced instructor" – NR	– NR
Vadiraja et al., 2009a, 2009b, 2009c	– VYASA – Movements, breathing practices, meditation, relaxation with imagery	– 60-minute sessions, 3–6 sessions per week over 6 weeks – NR – Audio recordings provided and home practice was recommended on days not attending yoga sessions	– NR – NR	– Available – NR – NR – NR
Pediatric studies				
Geyer et al., 2011	– BKY – Stretching, strengthening, balance, breathing, relaxation, body awareness	– 5 weekly 60-minute sessions over 2 months – Individualized group classes	– Physical and occupational therapists and assistants with specialized training in therapeutic yoga instruction	– NR – Modifications provided – NR – NR

		with BKY teachers and assistants – NR	– None	
Thygeson et al., 2010	– Peaceful Play Yoga (Hatha based) – Warm-up/centering, movements, final resting pose, meditation, inner peace was emphasized	– One 45-minute session – Group class – NR	– Registered yoga teacher – NR	– NR – Modifications provided – NR – NR
Wurz et al., 2014	– NR – Movements, group activity, cool down, final resting pose	– Twenty-four 60-minute sessions offered twice per week over 12 weeks – Group classes – NR	– Yoga certification – Training in yoga for cancer populations and children required	– NR – Modifications provided – NR – NR

BKY = Bendy Kids Yoga; NR = not reported; VYASA : Vivekananda Yoga Anusandhana Samsthana.

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During cancer treatment: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

According to Jnani Chapman, there are many side effects common to people undergoing cancer treatment, which can be debilitating and which can linger long after the treatments are completed. Some of the most common, she says, include "fatigue; pain; hand and foot neuropathies; joint and muscle aches; functional debilities; sleep disorders; and digestive, eliminatory, and sexual issues. Then there are the endemic anxiety, depression, and mood changes, not to mention threat to life and its concomitant emotional turmoil."

Chapman favors simple movements in asana practice, typically those that involve working in a single plane, as in turning the head from one side to the other. These simple movements "can provide circulation, range of motion, and stamina over time for students without taxing limited resources." They are also quite safe. Rather than using typical thin yoga mats, she uses "softer cushioned mats that offer genuine support."

Chapman often has students undergoing cancer treatment sit in chairs while they do yoga, so that they "can recall and mimic the breath and movement sequences when they are seated throughout each day."

She says that when she teaches small groups, “in the check-in that begins each class, people hear one another saying how they used the practices during the week. These personal testimonials go a long way in inspiring and motivating similar behaviors in others and in developing a safe community for sharing.”

Scott Blossom says that from an ayurvedic perspective, cancer is often linked with increased *vata dosha* and weak *agni* (digestive fire) in the tissues and low levels of *ojas* . Ojas is linked in ayurveda to immune function, contentment, and energy levels. Addressing these imbalances is vital to his approach to working with these patients.

Blossom recommends “restorative yoga and gentle postures in combination with *sama vritti ujjayi* pranayama*,* even during restoratives.” In this style of breathing, the student makes a gentle sibilant sound by keeping the glottis partially closed during the inhalation and the exhalation, which are equal in length. “The regulation of the breath seems to be the most important aspect of the practice, because in addition to soothing pain and nausea it also focuses the mind and reduces fear and anxiety. All of these qualities directly benefit agni and the immune system (ojas) by reducing excess vata. A vata-balancing lifestyle is critical to ensuring that these benefits are sustained.” He focuses on educating his students about how to structure their day in a way that balances vata dosha. Regularity of meal times, for example, is considered crucial.

Tadasana (mountain pose), Blossom says, helps to calm vata by encouraging grounding through the legs. He asks his students “to become aware of their feet bones and build their way up through their shins, thigh bones, pelvic bones, and spine to the crown of their head. I instruct them to relax their shoulders and breathe abdominally in a sama vritti ujjayi rhythm.” He may ask them to hold tadasana for 3 to 5 minutes, if they are able to. He generally asks these students to refrain from overly strenuous forms of yoga: “I believe that doing ‘hard styles’ of vinyasa has limited benefit, as does aggressive stretching or twisting.”

Among the restorative postures that Blossom has found useful in this population are *viparita karani* (legs-up-the-wall pose), supported child’s pose (*balasana*), and *supta baddha konasana* (supine cobbler’s pose) with sandbags placed on the hips (Figs 16.1–16.3). After making sure the students are comfortable, he will then “focus the majority of [his] instruction on guiding a rhythmic breathing pattern that includes gentle pauses at the top of the inhale and the bottom of the exhale while making hands-on assists to help people relax more effectively.”

Figure 16.1
Viparita karani.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Figure 16.2
Supported child's pose.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Nischala Joy Devi says, "Since a healthy lymphatic system has a crucial part in ridding the body of unwanted cells," she favors "slow deliberate poses to aid the movement of lymph." For example, wrist, arm, and ankle movements, while simple in action, have the effect of moving the lymph from the extremities. "If the client is able, one of the greatest poses to facilitate the movement of lymph is a simple assisted shoulderstand, followed immediately by fish pose. The purpose of inversion is to encourage the lymph system, which has no musculature of its own, to flow upward toward the heart. This 'reverse' flow, if done with ease, accomplishes the return of lymph."

Any pose offered, says Devi, "should be tempered and shown in a modified form for ease. It is important to remember when teaching a person undergoing treatment that their ability to participate is often based on how recent their latest infusion of chemotherapy or radiation treatment was and where they are in the cycle of treatment." She adds, "If body lines, ports, or pumps are present, all necessary adaptions are instituted in order for the benefits of the poses to be felt. For example, one of the many benefits of cobra pose is that the constant gentle pressure on the belly aids the flow of lymph and blood. However, even gentle pressure may not be advised if there is interference with any in-body apparatus. Placing a pillow under the chest area adjacent to the upper belly slightly elevates it, relieving undue pressure on the belly area and any obvious ports or drains. The pillow can be varied in size and shape to bring comfort while allowing the benefits of the pose to actualize."

Figure 16.3
Supta baddha konasana.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Devi has found that gentle pranayama and relaxation can also help. “The simple three-part yogic breath, when done with awareness, can subdue some of the physical symptoms.” For patients who have undergone surgery as part of their treatment, “the slow and gentle expansion of the belly and chest can allow the scarred area to begin to expand, and if adhesions are present often they are eased with time." This practice, or the "even more effective alternate-nostril breathing," she says, can also help soothe emotional disturbances.

Chapman stresses that "meeting physical needs is not enough. The yoga therapist needs to be comfortable conversing with students about what yoga says about the nature of the mind and the nature of reality, and the therapist needs to be willing to explore death, dying, and end of life with students when appropriate."

Resources

Book: *The Therapeutic Yoga Kit* by Cheri Clampett and Biff Mithoefer

Book: *Yoga for Cancer* by Tari Prinster

Book: *The Healing Path of Yoga* by Nischala Joy Devi

CHAPTER SEVENTEEN

YOGA THERAPY FOR CANCER SURVIVORS

SN CULOS-REED • R LONG • AA WALTER • M VAN PUYMBROECK

Introduction – yoga for cancer survivors

Cancer includes a large group of diseases that can impact any system within the body. The defining feature of cancer is the rapid creation and subsequent division of abnormal cells. These cells do not follow the "normal rules," moving beyond their usual boundaries and spreading to other parts of the body. In cancer, this is referred to as metastasis, which is the major cause of death from cancer (WHO, 2014).

The latest statistics indicate that cancer is a leading cause of death worldwide, accounting for approximately 13% of all deaths (8.2 million deaths) in 2012 (WHO IARC, 2012). However, given improvements in detection and treatment, cancer survivorship rates are also increasing, with an estimated 14.5 million cancer survivors in the United States in 2014. This number is projected to increase by 31%, to almost 19 million by 2024 (NIH, 2014). Given these significant growth rates in the number of cancer survivors, it is imperative that we examine how to positively impact the health and well-being of cancer survivors, ultimately enhancing their quality of life (QOL).

Rationale for yoga with cancer survivors

Yoga is a popular complementary and alternative medicine choice for cancer survivors. While the benefits of exercise in cancer survivorship are well established and guidelines exist (Schmitz, Courneya, & Matthew, 2010; Buffart, Galvao, Brug, Chinapaw, & Newton, 2014), the emerging research on yoga as a complementary therapy for survivors is in a relatively earlier research stage—but results are very promising (Culos-Reed, Carlson, Daroux, & Hately-Aldous, 2012; Lin, Hu, Chang, Lin, & Tsauo, 2011; Smith & Pukall, 2009). In particular, support for the value of yoga comes from Ross and Thomas's (Ross & Thomas, 2010) review of exercise and yoga. This work highlights that yoga is as beneficial as more traditional types of physical activity in improving a variety of health-related outcome measures (with the exception of physical fitness outcomes) in both healthy individuals and those with various health conditions (e.g., cancer).

Although this research examining yoga for cancer survivors is in its infancy, it is rapidly growing and yoga is increasingly integrated into cancer care (Tindle, Davis, Phillips, & Eisenberg, 2005). It is thus vital that the clinical benefits of yoga for cancer survivors are clearly recognized and emphasized within *posttreatment survivorship care* . Chapter 16 examines the literature examining yoga for cancer survivors on treatment.

Review of yoga and cancer research

Search criteria

A total of 15 studies were included in this review and analysis of published research on yoga for cancer survivors. These studies were found in Google Scholar and PubMed databases using the terms “yoga,” “cancer,” “survivor.” Studies were also found through professional communication and by referencing recent reviews (Culos-Reed et al. 2012; Buffart et al., 2012; Sadja & Mills 2013). Studies were included if they used a yoga intervention for cancer survivors and if all of the survivors were posttreatment. Studies were excluded if the participants were a mix of patients and survivors. Table 17.1 (see p. 382) illustrates the nine studies that were randomized controlled trials (RCTs) and Table 17.2 (see p. 386) presents the remaining seven studies that used various designs. All RCTs used a waitlist cancer control group except for Bower and colleagues (Bower et al., 2014), who used a health education control. The non-RCTs included five pilot studies and one intervention. The 15 studies included a variety of cancer diagnoses, including alimentary tract, breast, colorectal, gynecologic, hematologic, lung, lymphoma, prostate, and other.

Participant demographics

The average number of participants per study was 66, but this was positively skewed, because two of the studies had much larger participant numbers. Specifically, an RCT by Kiecolt-Glaser and colleagues (Kiecolt-Glaser et al., 2014) recruited 200 participants and an RCT by Mustian et al. (2013) recruited 410 participants. Excluding these two studies, the mean number of participants for the remaining 13 studies was 29.23 per study.

The mean age for participants across studies was 60.97 years; one study did not report the age or mean (Van Puymbroeck, Schmid, Shinew, & Hsien, 2011). Most participants in these studies were women; there were 25 men out of the 990 total number of participants in the 15 studies. As noted in Tables 17.1 and 17.2 (see pp. 382, 386), we included the terminology employed by authors for race and ethnicity. The majority of studies reporting these demographics indicated participants were white (670); Caucasian (26); or non-Hispanic white (9). Other races reported included African American (33); black (19); Asian (15); Asian American (1); Hispanic (2); and non-Hispanic black (2); other or non-white (5). Not all of the studies reported participants’ race or ethnicity (e.g., Culos-Reed et al., 2006; Littman et al., 2012; Mackenzie, Carlson, Ekkekakis, Paskevich, & Culos-Reed, 2013; Ross Zahavich, Robinson, Paskevich, & Culos-Reed, 2013; Speed-Andrews, Stevinson, Belanger, Mirus, & Courneya, 2010).

Participants’ time posttreatment ranged significantly within as well as across studies. A range of eligibility criteria included from one month posttreatment (Galantino, Desai, Greene, DeMichele, Stricker, & Mao, 2011) to years posttreatment (Bower et al., 2014; Culos-Reed et al., 2006; Mustian et al., 2013). For many studies, eligibility criteria included a range of months since treatment completion, with treatment completion defined as finishing chemotherapy and/or radiation. There is, to date, a range of timelines used in the eligibility criteria and little examination of differences in outcomes for survivors closer to or further out from treatment completion. Inclusion criteria varied across studies. Bower and colleagues (2014), for example, included participants between 10 months and 15 years posttreatment, with a mean of 4.6 years.

Outcomes

The 15 studies examined a variety of primary variables. Tables 17.1 and 17.2 (see pp. 382, 386) present the primary outcomes from each study. The most common primary outcomes were feasibility, QOL/health-related quality of life (HRQL), fatigue, other patient-reported outcomes (e.g., frequency of ongoing yoga practice (Mackenzie et al., 2014), and physical function/levels. Less common primary outcomes included breathing ease, pain, and body image. Given the multitude of potential outcomes, there was an array of assessment instruments employed across the 15 studies. Instruments included in a majority of studies to assess the primary variables were the Fatigue Symptom Inventory (FSI), Medical Outcomes Survey SF-36 (HRQL measure), Sit-and-Reach test, and the Functional Assessment of Cancer Therapy-Breast (FACT-B, HRQL measure).

Feasibility – measures of attendance, protocol adherence, and safety

Attendance at the yoga sessions was high across the majority of studies, as shown in Tables 17.1 and 17.2 (see pp. 382, 386). An average of 84.29% of participants across all studies completed the full intervention, with a range of 62–100%. Studies reported that participants completed an average of 81.92% classes across studies, with a range of 71.4–93%. These averages exclude Mackenzie (2014), because the intervention was a one-time yoga session. Encouragingly, attrition was low across studies. Participants' reasons for dropping out included time constraints, person decisions, and medical reasons unrelated to yoga. One study reported that a participant dropped out due to frustration with an inability to move down to and up from the floor with ease (Van Puymbroeck et al., 2011), an indication that future protocols should account for modifications. No adverse events were reported for participants engaging in yoga.

Results

Table 17.1 (see p. 382) displays the results found for the seven RCTs. Four of these studies revealed significant results in fatigue scores (Banasik, Williams, Haberman, Blank & Bendel 2011; Carson, Porter, Keefe, & Seewaldt, 2009; Kiecolt-Glaser et al., 2014; Littman et al., 2012) and two studies demonstrated decreased amounts of sleep disturbance after yoga participation (Carson et al., 2009; Kiecolt-Glaser et al., 2014). All other significant results can be found in Table 17.1 (see p. 382). The trends found in RCTs were Carson et al. (2009) in acceptance and negative mood and Culos-Reed et al. (2006) in gastrointestinal, emotional irritability, cognitive disorganization, depression, concentration, and total mood disturbance. The RCTs that found clinically significant results in their primary variables were Carson et al. (2009) in hot flash total score, joint pain, and symptom-related bother and Culos-Reed et al. (2006) in diarrhea.

Table 17.2 (see p. 386) outlines the results for the eight non-RCTs, highlighting the mixed findings. Three studies demonstrated significant improvements in QOL after the yoga intervention (Galantino et al., 2011; Mackenzie et al., 2013; Speed-Andrews et al., 2010). Three studies showed that yoga resulted in significant improvements in measures related to physical function immediately post-intervention (Bower et al., 2014; Ross Zahavich et al., 2013; Van Puymbroeck et al., 2011). Galantino and colleagues (2011) and Speed-Andrews and colleagues (Speed-Andrews et al., 2010) identified that participants reported significant decreases in pain. Bower and colleagues (2014) and Mackenzie et al. (2013) noted significant improvements in measures related to fatigue (e.g., average fatigue, tiredness, energy); Bower and colleagues (2014) also reported these improvements were sustained at the 3-month follow-up. Speed-Andrews and colleagues (Speed-Andrews et al., 2010) noted significant improvements in participants' mental health immediately after the yoga intervention. In the 7-week study by Mackenzie et al. (2013) there were no significant improvements in mood disturbances, although participants did have improvements at the 3- and 6-month follow-up time points. Similarly, participants showed significant improvements in measures related to mindfulness at both follow-up time points, with measures including acting with awareness, non-judgment, and non-reaction. Fouladbakhsh, Davis, and Yaradini (2013) found significant improvements in participants' respiratory function. All of the studies noted that the interventions were deemed feasible given high rates of attendance and participation without adverse events in yoga classes.

Evaluating yoga protocols for cancer survivors

As the field of yoga and cancer research expands, the scientific community is increasingly focused on the documentation and refinement of yoga protocols. This emphasis is important, given the need to replicate protocols in future research as well as to disseminate positive findings into community-based programs. The current review indicates that the design and reporting of protocols varied across the 15 studies. In order to promote more standardized design and reporting on yoga research involving cancer survivors, we drew upon Sherman's 2012 guidelines for developing yoga protocols (Sherman, 2012). Specifically, Sherman outlines eight domains that should be accounted for in a yoga protocol: (1) style of yoga (e.g., the tradition); (2) dose and delivery (i.e., frequency and length of classes, duration of program); (3) components of the intervention (e.g., asana, pranayama); (4) specific class sequences; (5) how modifications are dealt with; (6) selection of instructors; (7) facilitation of home practice; and (8) measurement of intervention fidelity over time (e.g., standardization of classes across teachers). In addition to this list, we propose that researchers describe if and how classes in a yoga intervention were progressive. Table 17.3 (see p. 390) highlights these domains across the studies, and the following takes a closer look at the reporting for each criterion within the 15 studies.

Style of yoga

The style of yoga fell into two broad categories. Out of the 15 studies reviewed, 6 were grounded in the Iyengar system and 7 were hatha-based programs, including two involving Viniyoga (Fouladbakhsh, Davis, & Yaradini, 2014; Littman et al., 2012). Several of the hatha-based interventions were through an established program for cancer survivors, Yoga Thrive (Culos-Reed et al., 2006; Mackenzie et al., 2014; Mackenzie et al., 2013; Ross Zahavich et al., 2013). The remaining two studies employed Yoga of Awareness (Carson et al., 2009) and Yoga for Cancer Survivors (YOCAS) (Mustian et al., 2013). A handful of researchers outlined their rationale for selecting the tradition or style of yoga. For example, Viniyoga was noted for the tradition's therapeutic adaptations, and Iyengar yoga was frequently cited for the emphasis on alignment and use of props, which were important for adapting to the medical conditions and mobility limitations of cancer survivors (Bower et al., 2011; Fouladbakhsh, Davis, & Yaradini, 2013; Littman et al., 2012).

Dose and delivery

The dose and length of delivery varied considerably across studies. Understanding the selection of an intervention's duration is important for evaluating the intervention's targeted outcomes and results, as well as for prescribing optimal doses for cancer survivors (Galantino et al., 2012). For example, there are varying intervention lengths for studies targeting different physiological responses, while behavioral interventions typically examine a minimum of 6–8 weeks to assess any significant impact on behavior change (e.g., adherence to practicing yoga). Class duration across all 15 studies ranged from 45 to 120 minutes, with a mean duration of 83.33 minutes (standard deviation of 15.24). Excluding one study that examined the impact of a single yoga session (Mackenzie et al., 2014), the mode for the intervention duration was 8 weeks (four studies), followed by 12 weeks (five studies). The number of classes per week was nearly evenly split between either one or two group classes each week, excluding home practice (see below). Class locations ranged from yoga studios and community centers to university campuses and cancer centers. No research to date has examined the impact of location (i.e., accessibility of location) on potential patient-reported outcomes (PROs). PROs related to location could provide researchers with important insight on strategies for translating research findings into community programs.

Components of yoga

Yoga is a unique mind–body intervention that offers researchers an array of therapeutic tools to evaluate for cancer survivors. Although yoga traditionally includes a primary focus on spiritual development, interventions for cancer survivors more commonly encompassed three primary components of yoga: asana, pranayama, and *dhyana* (meditation). All 15 studies included asana, while 10 studies also included pranayama and five included dhyana (Table 17.3 , see p. 390). Of these studies, four included the three aforementioned yoga components. The Yoga of Awareness program used by Carson et al. (2009) included the three primary components as well as yoga themes related to observing one's self without judgment and community (e.g., discussing person experiences through cancer and the yoga practice). The YOCAS program employed by Mustian et al. (2014) further outlined the mudras, visualizations, and affirmations used in classes.

Selection of instructors

All of the studies reported that the yoga sessions were led by qualified yoga instructors or qualified yoga therapists. Only four, however, noted that instructors had cancer-specific training. Multiple studies from the University of Calgary trained instructors through the Yoga Thrive Teacher Training Program, a multi-day training on therapeutic adaptations of yoga for cancer survivors (Mackenzie et al., 2014; Mackenzie et al., 2013; Ross Zahavich et al., 2013). One study selected instructors with YOCAS training, a program developed at the University of Rochester Medical Center (Mustian et al., 2013). Several studies where instructors did not have cancer-specific yoga training referenced levels of certification (e.g., senior and junior Iyengar instructors), experience teaching other clinical groups, supervision from senior teachers, or the inclusion of health professionals such as health psychologists, rehabilitation therapists, or nurses.

Facilitation of home practice

Eight studies encouraged participants to practice at home. Studies that reported active forms of support for independent practice demonstrated higher self-reported adherence to practicing yoga at home (Fouladbakhsh, Davis, & Yaradini, 2014; Galantino et al., 2012; Kiecolt-Glaser et al., 2014; Littman et al., 2012). The most common forms of support offered for home practice included DVDs, manuals with photos, and diaries to log practices. For example, Littman and colleagues (Littman et al., 2012) proactively supported participants' home practice through the provision of specific sequences in a DVD and manual as well as motivational interviewing. They reported that over their 6-month facility and home-based Viniyoga intervention, 32 participants completed a home practice an average of 55.8 times (SD 32.5)—approximately twice per week. Galantino et al. (2012) outlined a simple 15- to 30-minute home practice and followed-up with participants' home practice through email and phone calls; 80% of participants self-reported practicing yoga three times per week for 15 minutes. Fouladbakhsh, Davis, & Yaradini (2014) also employed a Viniyoga intervention that resulted in high rates of home practice. In their 8-week yoga intervention, 33% of participants reported practicing yoga daily while 67% practiced two to three times per week. These results are encouraging, because they demonstrate that given an appropriately designed home practice and adequate support, cancer survivors are willing to engage in yoga independently. An independent personal practice can support survivors in cultivating new healthy patterns for an active lifestyle. Further, a home practice may be instrumental in long-term adherence to other forms of physical activity.

Level of protocol reporting

We were encouraged by the detailed protocol reporting among the studies with cancer survivors. As noted by Sherman (2012), developing and reporting specific sequences is important in accounting for the physical limitations of study participants as well as the reproducibility of studies. Knowing a specific protocol is also paramount to translating research findings into an evidence-based program whereby yoga instructors can market specific benefits of a program (e.g., decreases in fatigue for cancer survivors). Of the 15 studies, 10 provided specific class sequences and poses, three listed the general class outline, and two noted that the protocol was available via another resource, such as a DVD. Ross Zahavich et al. (2013) provided the full 7-week protocol, which enables readers to evaluate the protocol's progression. It further provides researchers and practitioners with guidance for future studies and programs. Providing the full protocol, however, is not often possible given space limitations in journals. Two studies addressed the issue of space by providing an appendix of the exact postures and sequences in the online version of journals (Kiecolt-Glaser et al., 2014; Van Puymbroeck et al., 2011). As noted in Table 17.3 (see p. 390), several authors included the Sanskrit and English names or descriptions of yoga postures, whereas others only listed English names.

Given the medical considerations of cancer survivors, it is also helpful to understand specific breathing exercises used in a protocol if it is to be replicated or implemented in a program. For example, cancer survivors may experience cardiotoxicity as a late effect (Smith et al. 2010), especially those treated with anthracycline agents, such as breast cancer survivors, and breathing exercises that accelerate the heart rate, such as *kapalabhati* , should be taught with caution in these circumstances. Several authors reported specific pranayama practices, including practices that balanced the inhalation and exhalation and alternate-nostril breathing (Fouladbakhsh, Davis, & Yaradini, 2014; Mustian et al., 2013; Kiecolt-Glaser et al., 2014; Van Puymbroeck et al., 2011).

Intervention fidelity

Ensuring fidelity across yoga interventions is central to ensuring a protocol is delivered as intended (Sherman, 2012). Aspects of an intervention's fidelity include the design of the yoga protocol, training for yoga instructors, and materials or methods to ensure consistent delivery. Seven of the 15 studies reported measures of fidelity. As outlined in Table 17.3 (see p. 390), several studies reported standardized training for yoga instructors, such as the Yoga Thrive Teacher Training Program or YOCAS, or the creation of a yoga manual with standardized sequences and/or DVDs. In terms of confirming the delivery of the protocol, Carson et al. (2009) had classes videotaped and reviewed by the research team. Similarly, Kiecolt-Glaser et al. (2014) audiotaped classes and conducted a review of 50% of classes for deviation from the protocol. The authors reported high fidelity, with 97% of poses being delivered as scheduled. Mustian et al. (2014) assigned a research coordinator to conduct random observations in yoga classes. A gap in accounting for or reporting measures of fidelity, however, was actively involving yoga instructors in the consistent delivery of a protocol and reporting of modifications, e.g., through the use of checklists or regular research team meetings. The participation of yoga instructors at these stages can help ensure greater treatment fidelity. Further, their involvement will contribute to the development of yoga protocols that can be translated into clinic- and community-based programs.

Summary and future directions

The yoga and cancer survivorship research is growing, with 15 articles published since 2006 that have examined the effects of a variety of yoga interventions for individuals with cancer. These studies provide a preliminary foundation for understanding the impact of yoga on specific aspects of both physical and psychosocial function for cancer survivors off treatment. Given both the findings, as well as the limitations to date, the reader can take away many avenues for future research directions, as well as valuable points to consider when implementing a community-based yoga intervention for cancer survivors.

This research is critical, because yoga and yoga therapy are being offered at a number of cancer centers around the world (such as the Cleveland Clinic, Mayo Clinic, University of Texas MD Anderson, Memorial Sloan Kettering Cancer Center, and many others). The research accordingly builds the critical evidence base for implementing both safe and effective yoga programming for cancer survivors off treatment (see Chapter 16 for the growing evidence for the role of yoga for cancer survivors on treatment).

For cancer survivors, yoga provides a number of physical and psychosocial benefits. Yoga improves numerous sleep-related outcomes, including quality of sleep, sleep efficiency, and reduced daytime dysfunction. Yoga also improves psychological factors, including emotional well-being and QOL, vigor, acceptance, negative mood and depression, tension, stress, mindfulness, cognitive functions such as disorganization and concentration, and vitality. Physiologically, yoga improves feelings of fatigue; dyspnea; diarrhea and other gastrointestinal issues; menopausal symptoms, including hot flashes; joint pain; soluble tumor necrosis factor receptor type II; functional performance; respiratory function, pain severity, heart rate and heart rate variability, and morning and evening salivary cortisol. This wide range of improved outcomes is encouraging and provides a firm empirical foundation for offering yoga to cancer survivors off treatment.

Given the importance of yoga's components in collectively promoting mindfulness and relaxation, Sherman's (Sherman, 2012) suggestion that yoga protocols include a broader array of yoga's holistic elements is sound. These elements range from the eight limbs of yoga, including the *yamas* (ethical precepts) and *niyamas* (personal observances) to varying states of concentration and meditation. Many of these elements, such as the second niyama, *santosha* (contentment), may be particularly valuable to cancer survivors needing support in coming to peace with their current physical limitations or lifestyle changes as a result of their treatment. Although individual yoga instructors may weave these elements into class, there is tremendous benefit for future researchers and those implementing evidence-based programs to know the breadth of components included in the yoga program.

Suggestion for future research

Given the multifaceted needs of cancer survivors, we propose that future research in this field require yoga instructors to have therapeutic training beyond a 200-hour level teaching certification. Although a certificate in cancer-specific yoga is ideal, such programs are not widely available. In these instances, it is critical to include health professionals familiar with immediate and late effects of cancer treatment, such as lymphedema and cardiotoxicity, in the development of yoga protocols, as well as to review issues that may arise during the study. It is also important to study the impact of yoga during radiation and chemotherapy to determine benefits and assess any adverse events.

Another important area for future research to consider is that of protocol development and reporting. Most of the studies reviewed in this chapter provided some or all of the sequences and postures, and two provided information on how to obtain the protocol on DVD. Having the postures, sequences, and specific protocols is important for replicability in the community, as well as for extension of the yoga research in future studies, and this protocol reporting would be enhanced by including details of the breathing exercises that accompany the asanas. Protocols should also include the modifications that were used or that are suggested for each posture, in order to maintain the availability of yoga for all ability levels. Because each type of cancer affects the survivors differently, it is important that protocols targeted at specific cancers describe the particular postures or sequences used to address known problem areas, such as pelvic floor poses for prostate cancer survivors or poses that promote circulation in the chest for breast cancer survivors.

Furthermore, although many therapeutic adaptations may not have full classical names in Sanskrit, we encourage researchers to include both English and Sanskrit names for yoga postures and breathing practices wherever possible. This practice can be beneficial to researchers and practitioners alike since there is great variability in English names across yoga lineages and styles.

Van Puymbroeck et al. (2011, 2013) used mixed methods to explore qualitative and quantitative outcomes related to yoga participation for breast cancer survivors. Qualitative methods help to provide context and a rich understanding of the experiences felt by participants in the study. Future research is encouraged to employ mixed methods not only to provide more context to experience but also as a way to provide greater understanding of the experience in populations where yoga is underutilized. To date, the majority of participants in these studies were white/Caucasian, and this lack of diversity is of concern. Yoga interventions should explore different community settings to reach new populations, such as community centers or churches. These venues have been effective program locations for health-promotion interventions in African American populations (Yanek, Becker, Moy, Gittelsohn, & Koffman, 2001). Also, the use of a church to reach new participants may help to eliminate the concern of some people that yoga would interfere with or be counter to their religion (Desai et al., 2010), as well as providing greater outreach to rural populations.

Finally, it is important that future research continue to address treatment fidelity. This can be addressed by developing a manualized protocol; having instructors use check lists to indicate which poses were taught, modified, or omitted; and having regular check-in meetings between instructors and the research team. The development of consistent protocols and accounting for modifications needed for survivors as discussed above will support fidelity.

Table 17.1 Randomized controlled trials of yoga for cancer survivors

Author	Sample	Cancer type and treatment	Yoga intervention	Adherence	Outcome measures
Last name Year	**– *n* = – Age range: X–X – Mean age: yoga/control – Race**	**– Cancer type – Stage – Treatment (s) – Ave. time post-diagnosis and/or treatment – Range posttreatment**	**– Study duration – Duration, frequency**	**– # Completing protocol – % of class adherence or # of classes – # of drop outs**	**– Assessment – List primary variables**
Banasik et al., 2011	– $n = 18$ (yoga = 9; control = 9) – Age range: NR – Mean age: 62.86 63.33/62.4 – All Caucasian	– Breast (Stages II–IV) – > 2 mo. posttreatment	– 8 weeks – 2 ×/wk (90-min)	– 7/9 yoga participants completed; adherence 87.5%	– Weeks 0, 8 – Psychosocial function – Diurnal salivary cortisol secretion (acute, 4 ×/day for 2 consecutive days at weeks 0 and 8)
Bower et al., 2012; 2014	– $n = 31$ (yoga = 16; control = 15) – Age range: NR – Mean age: 53.86 – White (27), Hispanic (2), – black (1), other (1)	– Breast (Stages 0–II) – Radiation (24), chemotherapy (17) – Endocrine therapy (22) – Mean: ≥ 6 mo. posttreatment – Range: 0.7–4.1 years	– 12 weeks – 2 ×/wk (90-min) (4–6 participants per class) – Home practice encouraged	– 80% of yoga participants attended ≥ 20 out of 24 classes – Lost 2 to follow-up	– Weeks 0, 12; 3 mo. follow-up – Fatigue (blood and saliva samples)
Carson et al., 2009	– $n = 37$ (yoga = 17; control = 20) – Age range: NR – Mean age: 54.4 53.9/54.9 – White (30), African American (7)	– Breast (Stages I–II) – Surgery (46), Radiation (18), Chemotherapy (26) – Current AIs (22), Current Tamoxifen (5)	– 8 weeks – 120-min classes – Home practice encouraged	– Participants completed ave. of 6 out of 8 classes – Yoga group lost $n = 4$ post-assessment & $n = 4$ to the 3-mo. assessment	– Weeks 0, 8; 3 mo. follow-up – Daily menopausal symptoms (frequency and severity of hot flashes, pain, fatigue, mood, sleep, distress)
Culos-Reed et al., 2006	– $n = 38$ (yoga = 20; control = 18) – Age range: NR – Mean age: 51.18	– Breast (32), other (6) – Ave. 55.95 mo. post-diagnosis	– 7 weeks – 75-min weekly classes	– Not reported	– Weeks 0, 7 – QoL – Psychosocial

Kiecolt-Glaser et al., 2014	– n = 200 (yoga = 100; control = 100) – Age range: 27–76 – Mean age: 51.5 51.8/51.3 – White (176), black (18), Asian (5)	– Breast (Stages 0–IIIa; 0 = 18, I = 89, IIA = 52, IIB = 23, IIIA = 18) – Completed treatment within the past 3 years except for Tamoxifen/AIs – > 2 mo. post-surgery, adjuvant therapy, or radiation – Mean: 17.3 mo. post-diagnosis – Mean: 10.9 mo. posttreatment	– 12 weeks – 2 ×/wk (90-min)	– Participants in the YG attended an average of 75.4% of classes – 186 of all participants received 12-wk intervention & completed the immediate posttreatment assessment – 181 completed 12-wk posttreatment data	– Weeks-12, 24 – Psychosocial – Effects on inflammation – Health behaviors & support
Littman et al., 2012	– n = 63 (yoga = 32; control = 31) – Age range: 33–74 – Mean age: 60 60.6/58.2	– Breast (Stages I-IIIa) – > 3 mo. post-surgery, exception to Tamoxifen & AIs	– 6 mo. – 1 ×/wk (75-min) facility – 4 ×/wk (20–30 min) home-based	– Participants attended average of 19.6 (75.38%) of facility-based classes, practiced at home an average of 55.8 times (53.4% of the 4 × per week goal)	– Weeks-12, 24 – QoL – Physical activity – Anthropometric measures
Mustian et al., 2013	– n = 410 (yoga = 206; control = 204) – Mean age: 54.1 54.3/54 – White (383), African American (24), other (3)	– Cancer; breast (309), hematologic (30), gynecologic (19), alimentary (24), other (28) – Stages 0-IIII, unknown; 0 (21), I (145), II (137), III (64), IV (11), unknown (26) – Surgery (364) – Chemotherapy (286)	– 4 weeks – 2 ×/wk (75-min) – At home practice encouraged	– Average yoga attendance 6.5 of 8 sessions – Average dose of yoga 480-min of 600-min	– Week 0 & postintervention – Sleep quality

	– Radiation (266) – Hormone (28) – Current hormone (206) – 2–24 mo. post-surgery, postchemotherapy, and/or postradiation	

Table 17.2 Nonrandomized controlled studies of yoga for cancer survivors					
Author	**Sample**	**Cancer type and treatment**	**Yoga intervention**	**Adherence**	**Outcome measures**
Last name et al. Year	**– Study design** **– *n* =** **– Age range: X–X** **– Mean age: X** **– Race**	**– Cancer type** **– Stage** **– Treatment (s)** **– Ave. time posttreatment** **– Range posttreatment**	**– Study duration** **– Duration, frequency**	**– # completing protocol– % of class adherence or # of classes** **– # of drop outs**	**– Assessmen** **– List primar variables**
Bower et al., 2011	– Single-arm pilot – *n* = 11 – Age range: 46–65 – Mean age: 53.8 – White (9), non-white (2)	– Breast (Stages 0-II) – Surgery (3), surgery + radiation (4), Surgery + radiation + chemotherapy (4) – Mean: 4.6 years – Range: 10 mo. −15 years	– 12 weeks – 2 ×/wk (90-min)	– 11 completed 93% of classes	– Weeks 0, 12 3 mo. follow-up – Fatigue self-report – Psychosocial – Health-relate quality of life (HRQoL) – Physical function
Fouladbakhsh et al., 2013; 2014	– Quasi-experimental – *n* = 9 – 6 F, 3 M – Age range: 52–78 – Mean age: 67 – Caucasian (8), African American (1)	– Lung cancer (Stages I-III) – Surgery (44%), chemotherapy (50%)	– 8 weeks – 1 ×/wk (45-min) – Home practice encouraged	– 7 completed the protocol and 95% of classes	– Weeks 0–14 – Respiratory function, breathing ease (oxyge saturation and dyspnea – Sleep, mood salivary cortisol, quality of life (QoL) – Feasibility
Galantino et al., 2011; 2012	– *n* = 10 – Age range: 50–71 – Median age: 58 – Non-Hispanic white (9), Non-Hispanic black (1)	– Breast (Stages I–III) – > 4 weeks post-chemotherapy and/or post-radiation, all women taking aromatase inhibitors	– 8 weeks – 2 ×/wk (90-min) – Home practice encouraged	– 8 completed 12 of the 16 sessions, 1 completed 9 of the 16 sessions, 1 completed 3 of the 16 sessions – 80% adhered to the home-based program of 15 min 3 times per week	– Quality of life
Mackenzie et al., 2013	– Longitudinal study	– 62% breast, 10.6%	– 7 weeks	– Participants completed an	– Baseline, 8 weeks, 3 mo

	– n = 66 (M 7) (F 59) – Mean age: 53	lymphoma, 7.6% colorectal, 19.8% other – Majority Stages II–III approx., 2 years prior to study enrolment	– 1 ×/wk (75-min)	ave. of 5 out of 7 classes	follow up, 6 mo. follow u[p] – Affect – Mindfulness – HRQoL – Mental healt[h]
Mackenzie et al., 2014	– Cross-sectional study – n = 18 – Mean age: 54 – Caucasian	– 61% breast (Stages II–III) – Approx. 36 mo. prior to study enrolment	– Single private session – 1 × private (80-min) – Participants had completed a 7-week yoga program a mean of 4.9 times previously – Yoga	– 18 participants completed the 1 x private session	– Baseline – Attention – Affect – Cardiac activity
Ross Zahavich et al., 2013	– Pilot study – n = 25 (survivors (M 15) supporters (F 10) – Age range: survivors (48–81) support persons (49–72) – Mean age: survivors	– Prostate (Stages I–IV) – > 1 year posttreatment (4) – < 1 year posttreatment (8) – Active treatment (1) – Waiting/no treatment (2)	– 14 weeks (7 weeks of yoga class, 7 weeks of self selected physical activity) – 1 ×/wk (75-min)	– Survivors attended a mean of 6.2 yoga classes – Support persons attended a mean of 5.8 yoga classes	– Baseline, post-yoga program, 7-week follow up – QoL – Psychosocial – Fatigue

	(64.5)/support persons (60.6)	– Androgen deprivation therapy (4), Cryotherapy (4), radiation (6), chemotherapy (1), no treatment (2)			
Speed-Andrews et al., 2010	– Pilot study – *n* = 24 – Mean age: 54.8	– Breast (Stages I–III, unsure; I (7), II (5), III (7), unsure (4) – Surgery (23), radiation (19), chemotherapy (18) – Hormone therapy (10)	– Two different sessions: – 6 weeks – 2 ×/wk (90-min) *OR* – 12 weeks, 90 minute classes, 22 times	– 24 women completed baseline questionnaire – 17 completed post-program questionnaire, – Participants attended an average of 78.9% of sessions	– Baseline, post-progran questionnair – QoL – Psychosocial
Van Puymbroeck et al., 2011	– Nonrandomized two-group pilot study – *n* = 30 (yoga = 18; control = 12) – White (27), African American (1), Asian American (1)	– Breast – > 9 mo. posttreatment	– 8 weeks – 2 ×/wk (75-min)	– Yoga: 18 of original 29 completed study – Control: 12 of original 15 completed study – Average weekly attendance 90% from yoga & 95% control	– Baseline & posttreatme – Body image – Physical fitness – Physical activity constraints

Table 17.3 Yoga protocol details reported

Author, year	Style of yoga and intervention components	Dose Delivery Home practice	Q: Instructor qualifications C: Cancer specific yoga training	Reporting on (a) specific class sequences; (b) modifications; (c) progression; (d) measurement of fidelity
Banaskik et al., 2011	Iyengar Asana	8 weeks 2 ×/wk (90-min)	Q: Expert Iyengar instructors C: Not reported	a) Not fully reported, general description of class only b) Yes, generally discussed the use of props and modifications for safety c) Yes d) Not reported
Bower et al., 2011	Iyengar Asana, pranayama	12 weeks 2 ×/wk (90-min) Home practice encouraged	Q: Certified Junior Intermediate Iyengar Yoga Teacher with guidance from an Advanced Iyengar Yoga Teacher C: Not reported	a) Yes, listed 15 key postures (Sanskrit with English descriptions) b) Discussed pose modifications c) Yes d) Not reported
Bower et al., 2014	Iyengar Asana, pranayama	12 weeks 2 ×/wk (90-min) Home practice encouraged	Q: Certified Junior Intermediate Iyengar Yoga Teacher with guidance from an Advanced Iyengar Yoga Teacher C: Not reported	a) Yes, listed 17 key postures (Sanskrit) b) Yes, discussed why and how postures were modified, provided examples of how long postures were held, indicated a full list with photos is available c) Yes d) Yes, created a manual
Carson et al., 2009	Yoga of Awareness Asana, pranayama, dhyana, svadhyaya, satsang	8 weeks 120-min classes Home practice encouraged	Q: Classes co-led by a clinical health psychologist and yoga instructor with master's in health behavior and education C: Experience teaching to medical patients	a) Not fully reported, discussed rationale for Yoga of Awareness b) Yes, discussed modifications offered by instructors, and referenced details in Carson et al., 2007 c) Yes d) Yes, developed a manual with guidelines; videotaped and reviewed classes
Culos-Reed et al., 2006	Iyengar Asana, pranayama	7 weeks 75-min weekly classes	Q: Certified yoga instructor with BSc in kinesiology C: Not reported	a) Not fully reported, discussed the timing for class sections and the focus for relaxation/savasana b) Yes, discussed modifications offered c) Yes d) Not reported
Fouladbakhsh et al., 2013, 2014	Viniyoga (Hatha) Asana, pranayama, dhyana	8 weeks 1 ×/wk (45-min) Home practice encouraged	Q: Certified American Viniyoga Instructor; RN attended every	a) Yes, provided an example class sequence (postures in English) with specific breathing and meditation exercises

			class to monitor respiratory distress C: Not reported	b) Yes, noted the modification for individual needs c) Yes d) Yes, developed a manual
Galantino et al., 2011, 2012	Iyengar-inspired Asana, pranayama, dhyana	8 weeks 2 ×/wk (90-min) Home practice encouraged	Q: Certified yoga instructors with 500 + hours training C: Not reported	a) Yes, provided a precise outline of how classes were structured that lists postures by anatomical focus (Sanskrit with English descriptions), listed postures offered for the home practice b) Yes, discussed modifications for asana and pranayama c) Yes d) Not reported
Kiecold-Glaser et al., 2014	Hatha Asana, pranayama	12 weeks 2 ×/wk (90-min) Home practice encouraged	Q: Senior teacher led the initial group and provided videotapes to train 6 other certified yoga instructors C: Not reported	a) Yes, provided an appendix with all 24 postures (Sanskrit with English descriptions), the week postures were used in classes, and intended benefits; listed the 4 pranayama practices used b) Not reported c) Yes d) Yes, classes were audiotaped and 50% were randomly reviewed for protocol deviations
Littman et al., 2012	Viniyoga (Hatha) Asana	6 mo. 1 ×/wk (75 min) facility Home practice: 4 ×/wk (20–30 min)	Q: Two certified instructors with 10 years' experience C: Teachers had experience teaching cancer patients and survivors	a) Yes, outlined the flow of a class by each segment and provide example postures (Sanskrit with English descriptions) b) Modifications briefly discussed c) Not reported d) Yes, developed a manual
Mackenzie et al., 2013	Yoga Thrive Asana	7 weeks 1 ×/wk (75 min)	Q: 4 certified yoga teachers C: Yes, Yoga Thrive Teacher Training Program	a) Yes, described the timing and sequence of each class, referenced details in Ross-Zahavich et al., 2013, Culos-Reed et al., 2006, noted the use of a DVD set with the 7-week protocol b) Not reported c) Yes d) Not reported
Mackenzie et al., 2014	Yoga Thrive Asana, dhyana	Single private session 1 × private (80 min)	Q: Certified yoga teachers C: Yes, Yoga Thrive Teacher Training Program	a) Yes, discussed the standardization of the sequences, how postures were performed, and that the protocol was reported in Mackenzie et al., 2013 b) Not reported c) Not applicable d) Noted that the a standardized class was offered to each participant

Mustian et al., 2014	Yoga for Cancer Survivors (YOCAS) Asana, pranayama, dhyana	4 weeks 2 ×/wk (75 min) home practice encouraged	Q: Certified yoga teachers C: Yes, training through YOCAS	a) Yes, described the standard YOCAS class postures (Sanskrit and English) b) Not reported c) Not reported d) Yes, each instructor completed a standardized training session, received a manual and DVDs, a research coordinator conducted random observations
Ross-Zahavich et al., 2013	Yoga Thrive Asana	14 weeks (7 weeks of yoga class, 7 weeks of self-elected physical activity) 1 ×/wk (75 min)	Q: 4 certified yoga teachers C: Yes, Yoga Thrive Teacher Training program	a) Yes, described timing, sequence, and themes for each class in the 7-week protocol b) Not reported c) Yes, discussed weekly progression d) Not reported
Speed-Andrews et al., 2010	Iyengar Asana, pranayama	Two different sessions: 6 weeks 2 ×/wk (90 min) *OR* 12 weeks, 90 min classes, 22 times	Q: Senior Iyengar Yoga instructors under the supervision of Dr Geeta Iyengar C: Dr Iyengar provided curriculum suggestions to make classes breast cancer specific	a) Yes, described 15 postures used across all sessions (Sanskrit with English descriptions) and the meditative aspect of promoting breath awareness b) Yes, discussed use of props for modifications c) Not reported d) Not reported
Van Puymbroeck et al., 2011	Hatha Asana, pranayama, dhyana	8 weeks 2 ×/wk (75 min)	Q: Registered yoga therapist C: Not reported	a) Yes, provided a list of 37 postures and the 4 pranayama practices used (Sanskrit and English) b) Yes, discussed modifications c) Yes d) Not reported

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Cancer survivors: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Leigh Blashki says that “we cannot regard cancer survivors as a homogenous group. For those who have had radical surgery, there may be musculoskeletal weaknesses or imbalances that last for years. For those who have undergone extensive chemotherapy, long-term digestive issues such as dysbiosis can occur, as well as sleep disturbance, and extensive radiotherapy can lead to internal scarring that can impair the functioning of visceral organs.”

Shanti Shanti Kaur Khalsa says, “Recovery from cancer is as much about recovery from treatment as it is about recovering from the experience of having had cancer. From an ayurvedic standpoint, *prana* and *ojas* are depleted. There may be damage to the liver, kidneys, and heart from the treatment. Restoring effective immune function is also called for. Clinical experience indicates that for every year the cancer survivor was in treatment, there is a year of recovery, at minimum. The typical cancer survivor has had a year or more of complete upheaval in nearly every aspect of her [or his] life. There is a need to reset the compass point, to restore and regenerate her vitality and integrate the profound changes in herself and in her life.”

Khalsa continues, “Depression and anxiety may accompany a feeling of relief at facing and surmounting a life-threatening condition. Sometimes she does not know who she is or what to do with herself after putting all her resources into getting well. External and internal demands and expectations may lead her to make decisions that are not aligned with her emerging post-cancer identity.” Khalsa strives to “build and balance prana and restore ojas primarily through the practice of specific breath-based *kriyas* [sequences of practices] and diet.” These changes, she believes, “benefit immune function and provide the vitality needed to address life direction and other emotional and psychological factors.”

Blashki says, “Most cancer survivors I have dealt with as a yoga therapist have had to work through issues of trust in their own body, personal empowerment, and a questioning of their place in their family and community. For many, cancer has led to a ‘spiritual crisis.’ Some people have spoken of how the cancer has been something of an awakening, but others have described feeling as though they have lost their foundation of faith and belief. Many have sought to ascribe blame and carry anger for several years, which often exacerbates other psychoemotional issues.”

The main practices Blashki uses for these clients are meditation and relaxation exercises such as *yoga nidra* , chanting, and pranayama, “often as an entrée to meditation, as well as a stand-alone practice.” He most commonly recommends alternate-nostril breathing (*nadi shodhana*) and three-part (sectional) breathing. In addition, he does yogic counseling based on Patanjali’s *Yoga Sutras* , emphasizing the concept of the *kleshas* , obstacles to correct understanding and freedom from suffering.

Blashki finds that “for clients with residual postsurgical musculoskeletal issues, caution is required when teaching asanas that may overstretch affected areas. For example, in cases of radical mastectomy with pectoral reconstruction, strengthening may be more important than stretching.”

Beth Sternlieb says that “care needs to be taken to prepare the body for the asanas. For students who have never done any yoga or who have limitations due to surgeries or age or injuries, the asanas need to be modified and introduced incrementally and systematically with modifications so that the student is able to get the benefit of the correct actions of the asana without harm or injury.”

In working with breast cancer survivors with persistent fatigue, Sternlieb has had good results using supported inversions and restorative backbends. A key pose, she has found, is supported bridge pose (*setu bandha*), and she uses props made especially for this purpose. [N.B. This practice comes from Iyengar yoga and you are likely to find such props only in Iyengar studios.] She says, “The student lies over a bench with a rounded box attachment for the support of her chest. Her shoulders and head rest on a bolster and an additional blanket if needed for correct height. The legs are straight and held in place with a strap.” (See Fig. 17.1 .)

Setu bandha can also be done lying over two bolsters with the head and shoulders resting on a blanket. When done correctly, the tops of the shoulders just touch the blanket. The thighs are belted as shown (see Fig. 17.2), which reduces the work of the legs. This pose can be done instead of the version on the bench, or as part of a sequence leading up to that version, in which the backbend is stronger.

Savasana (corpse pose) can also be modified to be done as a supported backbend, using a bolster placed lengthwise under the torso and a folded blanket under the head. This setup can be used both for final relaxation and for pranayama. Sternlieb recommends starting pranayama by simply observing the breath, then moving on to *ujjayi* (victorious breath), gradually lengthening both the inhalations and exhalations.

Khalsa has found that “people newly diagnosed with cancer are willing to make important changes in their life, including taking up the practice of yoga. However, these changes are not always maintained once the person recovers. It is important to recognize that ‘recovery’ does not mean a return to the previous state before one was diagnosed,” as that may mean a return to the conditions that may have contributed to the illness in the first place. “Ideally,” she says, “Once treatment is complete, and often during the course of treatment, the cancer survivor begins to make fundamental changes in her thinking, in her relationship to self, to life, to work and to others. She will also make change in her diet and habits of daily living.”

Figure 17.1

A version of supported bridge pose, using special props.

Reproduced with permission from Beth Sternlieb, UCLA Pain Program, CA, USA

Figure 17.2
Another version of supported bridge pose.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

”Not everything has to change,” Khalsa stresses, “just a few key areas. And these changes need to be continued and sustained.” She finds that “there is the polarity of relief and inner conflict and often a rush to ‘put this behind’ her. However, taking the time to fully recover pays off in a more complete recovery.”

Above all, Khalsa stresses patience, advising patients, “Don’t rush the yoga practice and don’t rush the recovery.”

Resources

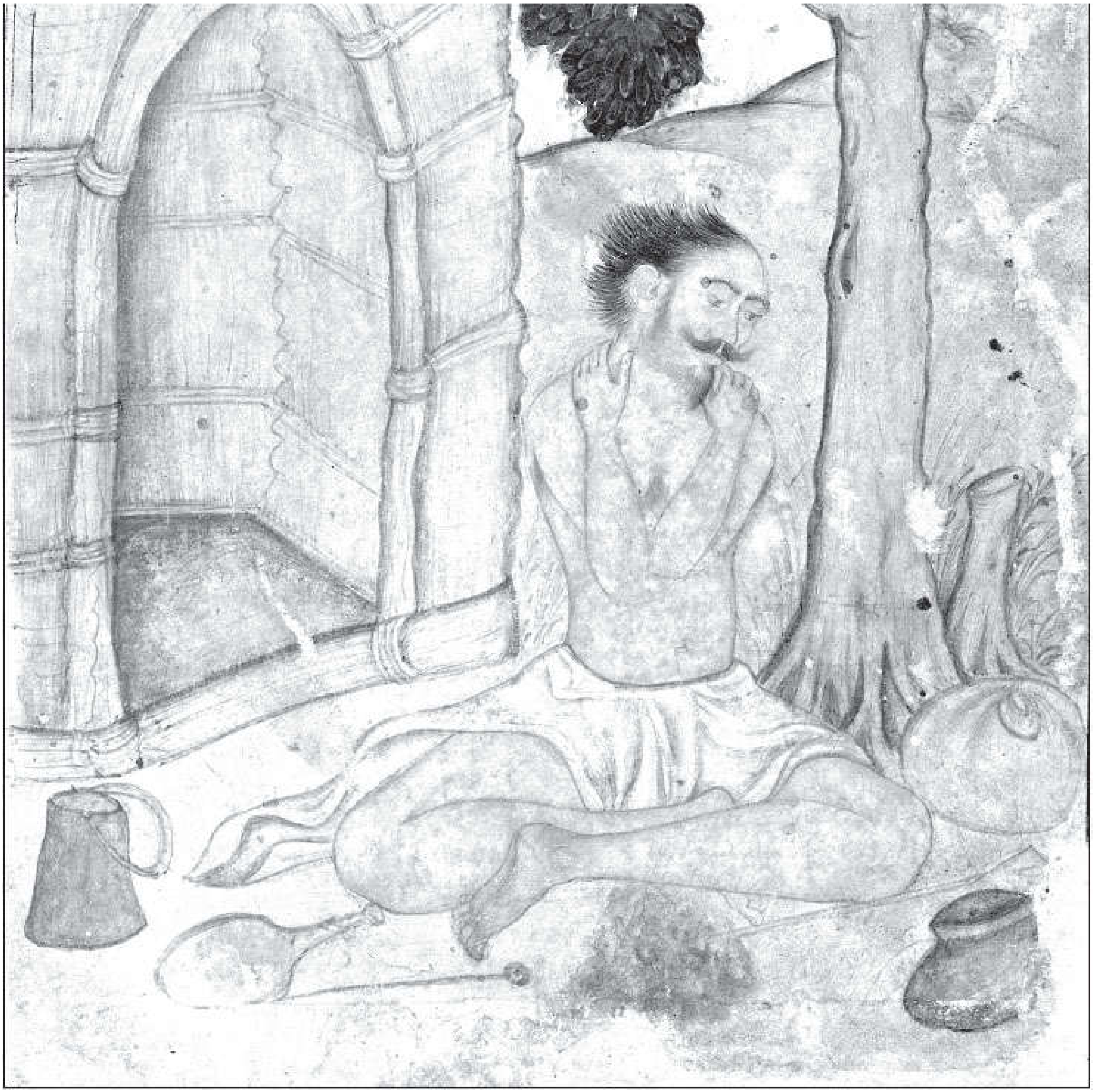
Book: *Quest for Life* by Petrea King

Book: *Yoga: A Gem for Women* by Geeta S. Iyengar

Book: *The Woman’s Book of Yoga and Health* by Linda Sparrowe and Patricia Walden

SECTION 7

SPECIAL POPULATIONS



From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.26a. © The Trustees of the Chester Beatty Library, Ireland.

CHAPTER EIGHTEEN

YOGA THERAPY FOR PEDIATRICS

S EVANS • ML GALANTINO • K LUNG • L ZELTZER

Introduction

The use of complementary and integrative medicine (CIM) is common. However, limited data are available on the use of CIM and factors associated with its use among the pediatric population in the United States (Birdee et al., 2009). In 2007, pediatric CIM users were more likely to take prescription medications, have a parent who used CIM, and have chronic conditions such as anxiety or stress, musculoskeletal conditions, dermatologic conditions, or sinusitis (Birdee et al., 2009). An overview of systematic reviews in 2011 evaluated the evidence for or against the effectiveness of CIM for any childhood condition and found 17 systematic reviews covering acupuncture, chiropractic, herbal medicine, homeopathy, hypnotherapy, massage, and yoga. Results were unconvincing for most conditions and many of the reviews failed to mention the incidence of adverse effects of CIM. The systematic reviews included in the overview tended to be of low quality, as were the randomized controlled trials (RCTs) within those reviews (Hunt & Ernst, 2011).

CIM data from the 2007 National Health Interview Survey were analyzed for youth from 7 to 17 years old. Readily accessible CIM therapies including yoga are commonly used by youth with attention-deficit hyperactivity disorder (ADHD), depression, and anxiety, particularly those who have comorbid chronic health conditions, receive prescription medications, and have difficulty affording counseling (Kemper, Gardiner, & Birdee, 2013). Furthermore, a meta-analysis suggested that yoga is a useful supplementary approach with moderate effect sizes on pain and associated disability (Bussing, Ostermann, Ludtke, & Michalsen, 2012).

Two systematic reviews to date have been published regarding the benefits of yoga in the pediatric population (Birdee et al., 2009; Galantino, Galbavy, & Quinn, 2008). In both reviews, the methodological quality of the studies was reported as low. In the first review, the effects of yoga on quality of life and outcome measures were explored. Areas for which yoga has been studied included physical fitness, cardiorespiratory effects, mental health, behavior and development, irritable bowel syndrome, eating disorders, and prenatal effects on birth outcomes. The majority of available studies suggest benefits to using yoga as a therapeutic intervention and show very few adverse effects. These results must be interpreted as preliminary because many of the studies have methodological limitations that prevent strong conclusions from being drawn. Further information about how to apply yoga most effectively and more coordinated research efforts are needed.

A growing number of RCTs have investigated the therapeutic value of yoga interventions. A recent bibliometric analysis of yoga papers published between 1975 and 2014 found a total of 366, of which 31 studies (9.9%) included children. This analysis presents the most complete up-to-date overview on published RCTs. While the available research evidence is sparse for most conditions, there was a marked increase in published RCTs in recent years (Cramer, Lauche, & Dobos, 2014). To provide clinicians with therapeutically useful information about yoga, the evidence evaluating yoga as an effective intervention for children and adolescents with health problems is reviewed and summarized through a review by Kaley-Isley et al. (Kaley-Isley, Peterson, Fischer, & Peterson, 2010). A brief overview of yoga and yoga therapy is presented along with yoga resources and practical strategies for clinical practitioners to use with their patients.

The objective of this chapter is to provide (1) a psychophysiological rationale for the use of yoga in children and adolescents, (2) a brief and practical overview of yoga research and how it might be applied as a complementary mind–body therapeutic tool in the general pediatric and adolescent population, and (3) a review of yoga applications for specific populations with medical conditions for potentially enhancing the treatment of health problems.

Physiological, cognitive, and psychological benefits of yoga

Yoga and meditation seek not only to reduce disease symptoms but also to enhance health by facilitating the mind’s capacity to optimize physical function (Leverone & Epstein, 2010; Purdy, 2013). Studies show that yoga fosters balance in the autonomic nervous system and regulates blood pressure by stabilizing sympathetic and parasympathetic nervous systems (Sengupta, 2012). Thus, through yoga practice, balance can be shifted from sympathetic to parasympathetic nervous system activity, which can result in positive changes to cardiac–vagal function and related neuroendocrine, metabolic, and inflammatory responses (Denollet, Schiffer, & Spek, 2010; Innes, Bourguignon, & Taylor, 2005). Yoga can reverse the negative impact of stress on the immune system by increasing levels of immunoglobulin A and natural killer cells while decreasing markers such as C-reactive protein and inflammatory cytokines (Ross & Thomas, 2010). Decreases in physiological arousal include reducing the heart rate, lowering blood pressure, and easing respiration (Ross & Thomas, 2010). Plasma melatonin has been reported to increase after sustained yogic practice, resulting in enhanced sleep quality and well-being (Sengupta, 2012).

Yoga and meditation are effective for stress management in children and adolescents (White, 2009), who face a host of social expectations, school demands, and stimulation through various online technologies. In fact, children today may face unprecedented challenges. Globalization likely impacts stress and mental health due to new, unfamiliar demands; changing cultural standards; and overwhelming options in daily life. Thus, finding safe and easily disseminated stress-management strategies for the pediatric setting may be more important than ever. Yoga appears to be effective when offered in schools (Serwacki & Cook-Cottone, 2012), although RCTs are needed. Yoga has the potential to enhance executive functions in children, which include reasoning, working memory, and self-control (Diamond, 2012), and yoga can improve resilience, mood, and self-regulation skills pertaining to emotions and stress (Hagen & Nayar, 2014).

The most-researched techniques in children and adolescents are the Mindfulness-Based Stress Reduction (MBSR) program, mindfulness-based cognitive therapy, mind–body techniques (meditation, relaxation), and body-mind techniques (yoga poses, tai chi movements). Current data are suggestive of a possible value of meditation and mindfulness techniques for treating symptomatic anxiety, depression, and pain in youth (Simkin & Black, 2014). However, it is important to note that clinicians and teachers must be properly trained before using these techniques with children and adolescents.

A recent review of studies by Field (Field, 2012) highlights the positive effects of exercise on weight, growth, chronic illnesses, depression, and anxiety in children and adolescents. Although most of the research has focused on aerobic exercise, studies on yoga have also shown benefits for these conditions. The yoga studies reviewed focused on psychological problems, including ADHD and anxiety, which were positively affected by yoga. A potential underlying mechanism for the positive effects of yoga may be enhanced vagal activity caused by the stimulation of pressure receptors. Increased vagal activity, in turn, leads to decreased stress hormones such as cortisol and pain chemicals, including substance P. Increased serotonin through vagal stimulation would be expected to contribute to less prevalence of depression and anxiety, as well as enhanced immune function. Further studies are needed using convergent behavioral, physiological, biochemical, and immune measures to enhance our understanding of these potential underlying mechanisms (Field, 2012; Gould et al., 2014).

Review of published literature

Method

We systematically searched multiple databases, including CINAHL, Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE, Medline, and PsycINFO, using the terms "child, adolescent, pediatric" along with "yoga" to perform a search of databases up to October 2014. We also searched the bibliographies of obtained yoga articles for additional publications that would meet our criteria.

A PubMed search with the terms "yoga (child* OR adolesc*)" yielded 428 citations. Many of these studies were preliminary, uncontrolled yoga studies with design limitations. However, pilot studies are important for documenting the safety, feasibility, and preliminary efficacy of yoga for specific populations, and the sheer volume of pilot studies published demonstrates the widespread application of yoga to pediatric populations. Pilots exist for such conditions as autism spectrum disorder (ASD), intellectual disability, and cancer in children. Some recent pilot studies of interest that showcase the breadth of yoga's applications include a 12-week community-based yoga intervention that improved quality of life and physical fitness in eight pediatric cancer patients (Wurz, Chamorro-Vina, Guilcher, Schulte, & Culos-Reed, 2014), a 10-month yoga breathing intervention for children with Duchenne muscular dystrophy that demonstrated significantly improved pulmonary function (Rodrigues, Carvalho, Santaella, Lorenzi-Filho, & Marie, 2014), and a daily 16-week yoga intervention for children with ASD that resulted in significantly reduced teacher-rated maladaptive behavior (Koenig, Buckley-Reen, & Garg, 2012). Previous reviews detail the results of pilot yoga studies in children, and should be examined by those readers wishing for additional information on preliminary results in pediatric yoga (Birdee et al., 2009; Galantino, et al., 2008; Ndetan, Evans, Williams, Woolsey, & Swartz, 2014).

Due to the volume of pilot and uncontrolled studies in the pediatric literature, we selected only RCTs to include and evaluate. The methodological quality of these 13 RCTs was assessed using the Jadad criteria (Halpern & Douglas, 2005).

1. Was the study described as randomized?

2. Was the study described as double blind?

3. Was there a description of withdrawals and dropouts?

4. Was the method of randomization described and appropriate?

5. Was the method of blinding described and appropriate?

A study with a score of 0–3 is considered low quality, and 4–5 is considered high quality.

RCTs were examined as long as they involved children and adolescents up to age 21. Studies that included both children and adults were excluded unless the results were specific to children, for example, if results were reported separately for children and adults. We did not limit selection to certain populations, and we included studies with any illness or disability. The literature fell into two fairly distinct categories, which guided our analysis and presentation of tables; namely, yoga for children with physical health challenges and yoga for psychosocial well-being in children.

RCTs of yoga for physical health conditions in children

A summary of the results pertaining to yoga for physical health issues in children is presented in Table 18.1 (p. 412). Two studies examined yoga for irritable bowel syndrome (IBS), one for polycystic ovarian syndrome in adolescent girls (the results are available in three separate publications), one for impaired vision, and one for poor physical coordination. The quality of evidence was varied.

Two studies of low-to-moderate quality have compared yoga to a waitlist control group for teens with IBS, a common disabling condition characterized by abdominal pain and altered bowel habits. The first study, by Kuttner and colleagues (Kuttner et al., 2006), examined 25 teens randomly assigned to either a mostly home-based 4-week yoga practice or to a waitlist group. The yoga group was provided with a single 1-hour instructional session with a yoga teacher and then sent home with a yoga program administered via video (requiring 10 minutes of daily practice). The yoga group as compared to the control group had decreased functional disability, emotional-focused avoidance, and anxiety. The investigators combined the data from the yoga group with the waitlist group after these subjects completed the intervention, and reported a pre- to postintervention reduction in gastrointestinal symptoms. Qualitative data from teens revealed they found yoga to be enjoyable and a useful pain coping strategy, and it increased their sense of well-being.

The second, more recent, IBS study examined a 6-week twice/week Iyengar yoga intervention for teens and young adults with IBS compared to a usual-care waitlist control condition (Evans et al., 2014). The results are presented separately for teens and adults, and the study was thus eligible for inclusion in the present review. The sample consisted of 30 teens (yoga n = 18; controls n = 12). Young adults in the yoga group experienced myriad benefits compared to controls, including improved IBS symptoms. Teens reported significantly improved physical functioning compared to control teens, and almost half of the yoga group teens reported clinically meaningful reductions in abdominal pain. The findings indicate that yoga, as taught in this study, had more robust results for the young adult subgroup than for teens. Other yoga studies that have examined results across development have also found differential response as a result of the participant's age (Brands, Purperhart, & Deckers-Kocken, 2011; Thygeson, Hooke, Clapsaddle, Robbins, & Moquist, 2010). It is possible that yoga interventions should be developmentally tailored to maximize benefits and dose-response effects should be determined. Limitations shared by both IBS studies include lack of an active control group, small sample size, and differential attrition rates between the yoga and control groups. Both studies also revealed barriers to the use of yoga as a long-term management strategy. In particular, home practice was difficult for teens to maintain in the face of other commitments such as homework and chores.

In a series of results by Nidhi and colleagues in India, an intensive daily 12-week yoga program involving poses, breathing, meditation, and yogic lifestyle education was compared to a similarly dosed active control condition of physical movement, nonyoga breathing and supine rest to treat polycystic ovarian syndrome (PCOS) in girls aged 15–18 years. PCOS is a highly prevalent female endocrine disorder that causes an imbalance in female hormones. The condition is associated with infertility and changes to physical appearance, including weight gain; untreated, PCOS may lead to type 2 diabetes and heart disease. The study is one of the few in pediatric yoga research to receive a high-quality classification of evidence. The sample was large, with 90 girls randomized to each group; adequate power calculations were described. A team of experts, including a gynecologist and a yoga therapy physician, devised the yoga and active control groups to ensure that the groups were adequately matched for nonspecific effects. Care was taken by the counselors not to introduce yogic concepts during the control sessions. Three publications relating to the study were published (Nidhi, Padmalatha, Nagarathna, & Amritanshu, 2012, 2013; Nidhi, Padmalatha, Nagarathna, & Ram, 2012b).

In the first report, self-reported anxiety was examined (Nidhi et al., 2012a). Changes in trait anxiety, but not state anxiety, were significant after the yoga intervention relative to the active control. It was concluded that holistic yoga is superior to physical exercise at reducing anxiety symptoms in teens with PCOS. The second and third publications were concerned with glucose metabolism (Nidhi et al., 2012b) and endocrine parameters (Nidhi et al., 2013). Results revealed that, compared to the active control group, girls assigned to yoga demonstrated improved fasting insulin, fasting blood glucose, homeostasis model assessment of insulin resistance, and blood lipid values. However, changes in body mass index, waist circumference, hip circumference, and waist-to-hip ratio were not significantly different. With respect to endocrine parameters, it was reported that a number of hormones involved in PCOS normalized in the yoga group, including testosterone and luteinizing hormone (a full description of hormonal markers is available in Table 18.1 , p. 412). Menstrual frequency also significantly differed between the groups at postintervention, reflecting normalized menstruation in the yoga group. However, body weight and body mass index (BMI) showed no significant differences between the groups. The series of findings provides the strongest evidence to date for the efficacy of yoga to treat a pediatric health condition. Not only does the study display adequate scientific design conventions, but the results are supportive of amelioration in biological and psychological facets of the disease. One final comment concerns the generalizability of the findings. The yoga intervention was administered daily to girls in a residential college. We are not convinced this delivery mechanism represents an ecological model of yoga. It is questionable whether adolescent girls attending regular high school in an industrialized country could or would participate in such an intensive intervention.

In an early study, Telles and Srinivas analyzed the cardiopulmonary effects of yoga on children with visual impairment (VI) (Telles & Srinivas, 1998). Previous studies found that young people with VI have significantly higher levels of anxiety than their age-matched peers, to which increases in heart rate is often attributed. In this study, 24 children with VI, aged 12 to 17 years, were age matched with normal-sighted peers. Half participated in yoga for an hour each day, while the other half performed physical activity, working in the garden and stretching. After 3 weeks, the rate of respiration was reduced in the children with VI who participated in yoga. There was no change in the children who participated in the physical activity group. These results were interpreted as demonstrating that although children with VI have higher physiologic arousal than children who are normal-sighted, this arousal may be reduced after participation in yoga. However, a common statistical error was made in that changes in the intervention group were not measured relative to the control group. Such within-group analysis limits the study's conclusions.

Engelman et al. analyzed the effects of yoga on poor physical coordination and body satisfaction in a study involving twelve 8-year-olds (Engelman, Clance, & Imes, 1982). Half received yoga and half received a control condition involving physical education. Children in the yoga group demonstrated improvements in self-image, while the control children did not. These results suggest that yoga may reduce the psychological burden of low body satisfaction or poor self-image resulting from poor physical coordination in children. The results from this RCT lend support to the notion that yoga may alleviate physical health concerns through improved psychosocial parameters. However, the study is of low quality, limited by such factors as under powering and failure to include an objective marker of poor physical coordination as an outcome. It is important to note that physical impairments are often heavily influenced by psychosocial factors.

RCTs of yoga for psychosocial health in children

Table 18.2 (p. 414) summarizes the RCTs of yoga for alleviation of psychosocial health problems in children and as a prevention effort for promoting psychosocial health in well children.

In a low-quality trial, Uma and colleagues (Uma, Nagendra, Nagarathna, Vaidehi, & Seethalakshmi, 1989) examined the efficacy of yoga as a therapeutic tool for children with intellectual disability, focusing on the effects of yoga on intelligence and social behavior. Ninety children between the ages of 6 and 16 years were randomized into either the experimental yoga group (n = 45) or the usual-care control group (n = 45). Based on the Binet Kamat (BK) and Seguin Form Board (SFB) scores, children were classified as having mild, moderate, or severe intellectual disability. The Vineland Social Maturity Score (VSMS) was used to evaluate social age. Children were matched according to age, sex, and IQ, and one from each pair was randomly assigned to each group. Treatment took place daily for 1 hour, 5 days a week for a total of 10 months. Attendance was found to be satisfactory in both groups. The yoga group demonstrated significant improvement in BK scores, with 89% of the yoga group improving compared to 57% in the control group. Findings were interpreted as indicating that yoga can help improve the IQ and social adaptation of children with intellectual disability, most notably at mild and moderate levels. However, the study calculated outcome changes incorrectly (difference between yoga and control group measurements at baseline compared with difference between yoga and control group measurements post intervention). Based on the quality of the study, it provides limited evidence that yoga can improve IQ.

Yoga is also viewed as a potential complementary intervention for children with ADHD. Jensen et al. (Jensen & Kenny, 2004) evaluated the effects of yoga on the behavior and attention of boys (ages 8–13 years) with ADHD, who were currently using pharmacology. Using a randomized crossover design, boys diagnosed with ADHD were randomized into yoga (n = 11) or a control group involving cooperative games (n = 8). Attendance in the yoga group was variable. The yoga group demonstrated significant improvement on oppositional, emotionally labile, restless/impulsive, and ADHD indices, while the control group showed significant improvement on hyperactivity, anxious/shy, and social-problem scales. Boys who had attended a greater number of yoga sessions demonstrated a more prominent reduction in ADHD symptoms on the Hyperactive-Impulsive and Inattentive subscales. There were several limitations to this study, notably an incorrect use of statistics that did not directly compare yoga and control groups, the small sample size, baseline group differences in ADHD symptoms, and variability in number of classes attended and amount of home practice. Moreover, the control group games were administered at a substantially lower dose (only 1 hour class/month) than the yoga group treatment. Overall, yoga may have potential as a complementary treatment for boys with ADHD who are taking medication, but additional large-scale research is needed before recommending yoga as a reliable therapy for this condition.

A high-quality study explored the effect of yoga on eating disorders in adolescents receiving outpatient care for eating disorders (Carei, Fyfe-Johnson, Breuner, & Brown, 2010). A total of 50 girls and 4 boys (aged 11–21 years) were randomized into an 8-week program of either yoga plus standard care (n = 26) or standard care only (n = 27). The yoga group consisted of biweekly 1-hour yoga sessions for 8 weeks. Outcomes measured include Eating Disorder Examination (EDE), BMI, Beck Depression Inventory, State Trait Anxiety Inventory, and food preoccupation. Assessments were conducted at baseline, postintervention (week 9), and at 1-month follow-up (week 12). EDE scores decreased in both groups between baseline and Week 9. However, scores in the yoga group continued to decline up to Week 12, while EDE scores in the control group returned to baseline by Week 12. Both groups demonstrated decreased anxiety and depression. Participants cited decreased food preoccupation after engaging in yoga. There were several study limitations, notably the small sample size within each diagnostic subgroup and the possibility of results not translating to inpatient or community populations. However, results from this high-quality trial suggest that individualized yoga therapy may be beneficial when coupled with standard medical care in adolescents diagnosed with eating disorders.

The processes initiated by yoga practice have the potential to impact the more global issues of socialization and stress management. A number of RCTs have targeted stress and promotion of mental health in general populations of healthy children. Although this chapter has focused on trials with children who have health challenges, review of this additional RCT literature provides an appreciation of the use of yoga in children to promote wellness.

A number of RCTs have tested yoga within a school curriculum to evaluate preventive efficacy for psychosocial well-being. For example, two RCTs by Khalsa and colleagues have demonstrated that yoga is feasible and acceptable and has the potential for preventing mental health problems in teen school students (Khalsa, Hickey-Schultz, Cohen, Steiner, & Cope, 2012; Noggle, Steiner, Minami, & Khalsa, 2012). In the first study of 109 students, those randomly assigned to a Yoga Ed. program versus regular physical education showed statistically significant differences over time relative to controls on measures of anger control and fatigue/inertia (Khalsa, et al., 2012). In the second study of students attending a rural public high school (Grades 11 and 12) cluster randomized to either a Kripalu-based yoga intervention (2–3 sessions over 10 weeks) or physical education, students assigned to yoga reported improved mood and tension-anxiety and affect relative to the physical education group. Students rated yoga fairly high despite only moderate attendance (Noggle, et al., 2012). Further support for the use of yoga in schools for wellness was demonstrated in a study involving four urban public schools. Ninety-seven students (fourth and fifth graders) were randomized to a 12-week yoga/mindfulness intervention versus a waitlist control. Findings demonstrated improvement in the yoga group relative to controls on measures of rumination, intrusive thoughts, and emotional arousal (Mendelson et al., 2010). Despite the large sample size, the cluster nature of the data weakens the statistical interpretation.

However, not all findings with well children demonstrate support for yoga in alleviating or preventing mental health problems. In a randomized cluster design with two public schools, 8- to 11-year-old girls assigned to 8 weeks of mindfulness/yoga (1 hour classes and 10 minutes of daily homework) versus a waitlist control group demonstrated greater coping, but also greater appraisal of stress than the control group (White, 2012). Another recent RCT involving 30 children aged 10–11 years randomized to a yoga or physical education class 3 times a week for 12 weeks found increased negative affect in the yoga group. There were no other significant changes between the groups on a number of parent-reported and child-reported measures of psychosocial health (Haden, Daly, & Hagins, 2014). It is possible that the increase in children's awareness of stress and negative affect in these studies was a product of increased mindfulness of emotions as automated reactions to such stress are lessened over time. Follow-up data is required to understand the long-term implications of mindfulness/yoga training in children.

Generally, limitations of studies with well children in the school setting include small sample sizes, uneven attrition between groups, and lack of long-term follow-up measures for sustainability. Findings should be regarded as demonstrating mixed support for improving mental health outcomes in well children.

Summary and conclusions

Areas for which pediatric yoga has been studied using an RCT design include mental health, eating disorders, IBS, visual impairment, and hormonal problems. A large majority of the studies showed benefits for children with these conditions; however, it is not clear whether yoga's positive effects are proportionate in children who are well. From the brief literature summarized here, it appears that yoga may be most powerful when treating an underlying deficiency, and its application in a prevention setting with well children is less apparent over the relatively short-time course of the studies conducted to date.

The general findings are tempered by clinical trial design and data analysis and reporting problems. Of the total 13 studies we identified (the Nidhi publications on PCOS are counted here as one study), we classified three as Level 1, five as Level 2, two as Level 3 and three as Level 4 on the Jadad scale. Although description of randomization was generally clear throughout the studies, there was less data describing blinding, and information on withdrawals and dropouts was often missing. The methodological quality of many of the early RCTs of yoga for pediatric illness and disease was low; overall, studies were of moderate-to-low quality. However, we are encouraged to see that more recent studies have improved in their trial design and reporting. Future investigations should incorporate all aspects of a rigorous clinical trial, including information relating to blinding, dropouts, and adherence, as well as having sufficient power to detect effects. Appropriate use of statistics, while not included under the Jadad criteria, was also a problem in many of the studies.

Poor adverse-event reporting in the majority of studies limits conclusions about the safety of yoga as exercise for children. In addition, the relatively small sample sizes provide insufficient power to detect meaningful differences in rates of rare adverse events. For example, inverted postures are thought to have a positive impact on anxiety symptoms but may not be recommended for some patients, yet none of the studies reviewed explained or monitored for the effects of specific postures. That being said, certain traditions of yoga, such as Iyengar yoga, in which practitioners have extensive training and certification processes, are likely to be safe when practiced with a trained teacher.

Future research is ripe for understanding the use of yoga in the pediatric setting. Apart from the need for sufficiently large, well-designed clinical trials, we also have limited information about possible mechanisms involved in yoga's beneficial effects. Yoga can be utilized by children as an adjunctive and supportive self-care practice rather than relying only on a clinician to “do something” to them, which can substantially enhance the child's sense of self-efficacy and coping. Yoga may also bring homeostasis to biological processes, as demonstrated by the study on PCOS. Psychological processes may also underlie therapeutic action, including ameliorating fear of activity, anxiety, depression, and general reduction in stress.

Another area worth exploring includes developmental tailoring of yoga interventions. Teens are likely to benefit from a different yoga approach than younger children, who may benefit more from the physical, playful aspects of yoga. Teens may be a particularly difficult group to treat (Evans, et al., 2014), so a range of considerations need to be taken into account, such as how yoga interventions can be delivered in a way that is most feasible and enjoyable given adolescents' busy schedules and motivation challenges. It is possible that more structure and peer interaction (e.g., group classes) or individualized and online programs may enhance adolescent motivation for completing daily yoga practice. It is our hope that as pediatric yoga research expands, further research refinements will address concerns related to clinical trial design and developmental issues in the timing, structure, and delivery of yoga for different age groups and different clinical populations.

Table 18.1 Summary of RCTs of yoga for physical health conditions in children

Author/year	Health issue	Intervention	Control condition	Age	Outcomes	Summary	Evid… leve…
Evans et al., 2014	IBS	Iyengar yoga Twice/week 1.5 hr classes for 6 weeks	Waitlist; usual care	14–26 y.o.	IBS symptoms Pain intensity via NRS Health-Related Quality of Life Functional Disability Index Brief Symptom Inventory-18 FACIT Fatigue Pittsburgh Sleep Quality Index	Yoga teens (14–17 yrs) ↑ physical functioning compared to controls 44% of yoga teens reported a minimally clinically significant reduction in pain	3
Kuttner et al., 2006	IBS	Hatha/Iyengar yoga Initial 1-hr session, and 4 weeks of daily home practice video	Waitlist; usual care	11–18 y.o.	Pain Intensity via NRS, GI symptoms Functional Disability Inventory Pain Coping Questionnaire, Revised Child Manifest Anxiety Scale Children's Depression Inventory	Yoga group: ↓ functional disability, emotion-focused avoidance, and anxiety Combined yoga and waitlist data = ↓ GI symptoms after yoga	2
Nidhi et al., 2012a	PCOS	Holistic Yoga 1 hr daily, 7 days a week for 12 weeks (total 90 sessions)	Active control: movement, non-yoga breathing, supine rest	15–18 y.o.	STAI	Changes in trait anxiety, but not state anxiety, significant after yoga compared to physical exercise	4
Nidhi et al., 2013	PCOS	As above	As above	As above	Anti-Müllerian hormone, luteinizing hormone, follicle stimulating hormone Testosterone, prolactin	↓ AMH, LH, testosterone & hirsutism & improved menstrual frequency in yoga compared to controls	4

					Body mass index, hirsutism Menstrual frequency		
Nidhi et al., 2013b	PCOS	As above	As above	As above	Fasting insulin Fasting blood glucose Insulin resistance Blood lipid values BMI	Yoga more effective than physical Exercise in improving glucose, lipid, and insulin values, including insulin resistance values	4
Telles & Srinivas,1998	Impaired vision	Unspecified yoga 1 hour daily, 5 days a week for 3 weeks	Outdoor physical activity	12–17 y.o.	HR RR Skin resistance	Yoga group: ↓ in breathing rate Control group: no change	1
Clance et al., 1980	Poor physical coordination	Unspecified yoga 3 × per week for 4 weeks; each session 30 mins	Physical education	8 y.o.	Children's Body Satisfaction Test Human Figure Drawing test with number of emotional indicating body dissatisfaction	Yoga: ↓ negative responses in Children's Body Satisfaction Test & ↓ emotional indicators in Human Figure Drawing test Controls: no changes in body satisfaction	2

AMH: antimullerian hormone; BMI: body mass index; FACIT: Functional Assessment of Chronic Illness Therapy; GI: gastrointestinal; HR: heart rate; IBS: irritable bowel syndrome; LH: luteinizing hormone; NRS: numeric rating scale; PCOS: polycystic ovarian syndrome; RR: respiratory rate; STAI: State Trait Anxiety Index.

Table 18.2 Summary of RCTs for psychosocial health in children

Author/year	Health issue	Intervention	Control condition	Age	Outcomes	Summ
Jensen & Kenny, 2004	ADHD	Yoga Weekly 1-hr classes for 20-week duration	Cooperative activities/games	8–13 y.o.	CTRS-R:L CPRS-R:L TOVA Motion Logger Actigraph	Yoga g improv five su CPRS (Oppos Global Emotic Global Global Restle: and AI Those home showe improv TOVA a Contro improv three C subsca (Hyper Anxiou Social
Uma et al., 1989	Intellectual disability	Yogic practices 1 hr daily, 5 days a week for 10 months	Usual routine	6–15 y.o.	Binet Kamath (IQ) Seguin Form Board Vineland Social Maturity Scale	↑ IQ a adapta param yoga g compa contro
Carei et al., 2010	Eating disorders	Viniyoga 1-hr semi-weekly for 8 weeks (1:1 instruction)	Standard care (every other week physician and/or dietician appointment)	11–21 y.o.	Eating disorder examination Body mass index	Yoga g greate sympto scores preocc after e Both g mainta curren anxiet depres time
Haden et al., 2014	Emotional/behavioral functioning in well children	Ashtanga yoga 1.5-hr sessions 3 × per week for 12 weeks	Physical education class	10–11 y.o.	Positive and Negative Affect Scales Child Behaviour Checklist Revised Parent Rating Scale for	Yoga: affect compa contro

					Reactive and Proactive Aggression Self-Perception Profile for Children Global Self-worth Scale Student Engagement questionnaire	
White et al., 2012	Stress in well children	Yoga 1 hr per week for 8 weeks & 10 minutes of daily homework	Waitlist control	8–11 y.o.	The Feel Bad Scale Schoolagers' Coping Strategies Inventory The Global Self-Worth subscale of the Self-Perception Profile for Children Mindful Thinking and Action Scale for Adolescents	↑ self- self-re both g Yoga g apprai and ↑ of copi compa contro
Mendelson et al., 2010	Stress in underserved, well youth	School-based Mindfulness and Yoga Intervention 45-min sessions, 4 × week for 12 weeks	Waitlist control/usual care	9–11 y.o.	Response to Stress Questionnaire Short Mood and Feelings Questionnaire – Child Version Emotion Profile Inventory People in My Life	Yoga g signific improv involur engag rumina intrusi and er arousa to cont
Khalsa et al., 2012	Mental health in well children	Yoga Ed program 30 min (3 classes) or 40 min (1 class) 2–3 × per week for 11 weeks	Physical education class	15–19 y.o.	Self-Report of Personality Profile of Mood States Resilience Scale Perceived Stress Scale Inventory of Positive Psychological Attitudes-32R	Yoga g improv anger fatigue compa contro

Noggle et al., 2012	Mental health in well children	Kripalu Yoga 30-min classes 2–3 × per week for 10 weeks (Total = 28 sessions)	Physical education class	Mean = 17 yrs	Profile of Mood States Positive and negative affect schedule for children Perceived Stress Scale Inventory of Positive Psychological Attitudes-32R The State-Trait Anger Expression Inventory-2 The Child Acceptance and Mindfulness Measure	Yoga g mood disturb mood- and ne affect compa contro Secon outcor not sig differe

ADHD: attention-deficit hyperactivity disorder; CPRS-R:L: Conners' Parent Rating Scale-Revised; CTRS-R:L: Conners' Teacher Rating Scale-Revised; EDE: Eating Disorder Examination; IQ: intelligence quotient; TOVA: Test of Variables of Attention.

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Pediatrics: clinical insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Lisa Kaley-Isley says, “Already by the early years of adolescence teens are developing bodily stresses and strains from long hours of sitting, study, and computer game playing, and carrying heavy backpacks. They have tight hamstrings and shoulders, and increasingly they do not get very much physical activity. Puberty brings considerable physical changes so that teens are often very aware of their bodies, but not necessarily very comfortable in them. Younger children tend to be full of energy, but by adolescence they are increasingly sedentary and sleep deprived.”

”Children and adolescents,” says Kaley-Isley, “benefit from an integrated yoga practice that includes movement, asana; conscious breathing, pranayama; relaxation; and meditation. Asana helps children discharge restless energy in a constructive manner, develops proprioceptive and interoceptive awareness, facilitates functional posture and alignment patterns, relieves stresses and strains, may reduce the likelihood of athletic injury, and increases feelings of positive self-embodiment.”

Beth Sternlieb says, “Children who have chronic health and pain problems are often increasingly dependent on their parents at a time when they would normally be developing more autonomy and independence. Yoga can give them an increased sense of competency as well as a sense of well-being, confidence, and mastery. It is important to give poses that make them feel that they are growing and developing new skills and that they are actively participating in their healing process."

Kaley-Isley says, "Conscious breath regulation is an extremely effective technique for enhancing energy and inducing calmness, and it can be done anywhere, anytime, including at school and before exams. Once they feel safe and guided into the state to experience it, children and adolescents love relaxation. It is a desirable antidote to stress at any age, and learning early in life how to create this experience for oneself is invaluable for lifelong coping." Visualization exercises and simple meditation practices, she says, build one's capacity for concentration and attention.

When working with children and adolescents, Kaley-Isley says, the duration of the practice, the language used, and choice of activities all must be geared to their cognitive and developmental age. "For example, younger children can usually concentrate through a shorter 30- to 45-minute class, holding poses for only brief periods, and they like using animal and nature names for the poses. Incorporating the poses into a story, game, or song are other creative ways to keep their interest and impart yogic ideas. In contrast, older teens can maintain attention for a 60-minute class, sometimes like learning the Sanskrit names for poses, can stay longer in relaxation, and often like the mastery challenge of more complicated or balance poses."

Kaley-Isley says, that children with conditions such as developmental disorders, a history of trauma and abuse, anxiety and depression, hyperactivity, aggressiveness, and eating disorders may benefit from different teaching approaches as regards “physical contact; a noncompetitive attitude; clear boundaries; and creation of a safe space for exploration, adaptation, and play.”

One patient population that Sternlieb has worked with is children with irritable bowel syndrome (IBS). “Children who have experienced intense physical and emotional pain are often guarded and contracted in their bodies,” she finds. “They need to learn that not all sensation in the body is harmful. For example, I may tell them that if their hand had been in a fist for a year it would hurt to open their hand, but this would actually be a good thing. Of course, we need to open at a pace that is tolerable.”

Figure 18.1

Restorative backbends stretch the front of the abdomen and may provide relief in some children with abdominal pain.

Reproduced with permission from Beth Sternlieb, UCLA Pain Program, CA, USA

Sternlieb says, “Children with abdominal pain can learn to enjoy stretching their bellies and will very often feel some immediate relief when they do.” She has found various supported backbends particularly helpful, including *viparita dandasana* (inverted staff pose) over a chair, and the gentler supported backbend shown in the photo (Fig. 18.1). These poses, she says, “extend the abdomen, increase the ability to tolerate sensation, reveal unconscious tension, and provide relief.”

Carrie Demers says, “When kids and adolescents have chronic sinus problems, colds and flu, or allergies, I teach them how to wash their noses with saline solution using a neti pot. This practice, while initially daunting, is so easy once learned, and is consistently helpful. I have taught this practice to kids as young as 6 years old. This age group benefits from a parent who also does it regularly, for support."

"The general theory of the nasal wash," Demers says, "is that we breathe in particulate matter every day—germs, dust, pollen, debris—and our bodies react to that by getting sick or having allergy symptoms. When you wash away those particles by this gentle process of pouring normal saline through the nose, there is no more reason for the body to react."

For kids who are cancer survivors and for others who suffer from fatigue, Sternlieb finds that supported inversions, such as the headstand variation, done hanging from wall ropes (Fig. 18.2) can be helpful. Wall ropes are found in some yoga studios and can also be installed in homes. A blanket or two is typically placed between the hips and the ropes for padding. She says, "Circulation is promoted by inversions. Students with persistent fatigue find supported inversions deeply restful." Plus, she says, "Kids love to hang upside down. Inversions bring a feeling of fun and freedom. They will often ask me to take a picture of them so they can share with family and friends, as if to say, *'Look what I can do! Yoga is really cool'* . "

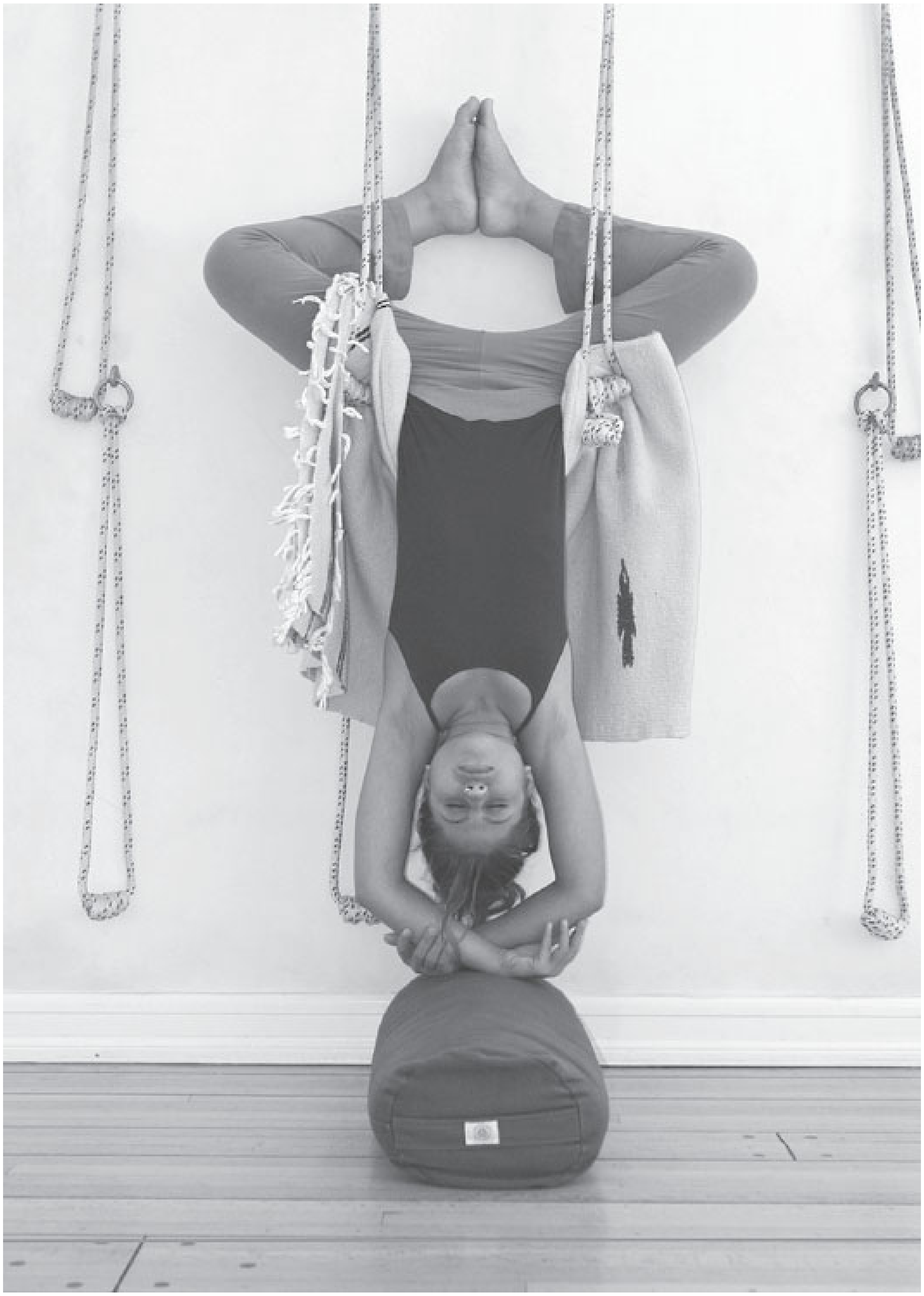

Figure 18.2
In this variation of headstand, done hanging from wall ropes, the legs are in *Baddha Konasana* position, with the soles of the feet together.

Reproduced with permission from Beth Sternlieb, UCLA Pain Program, CA, USA

Resources

Book: *Yoga for Children* by Lisa Flynn

Book: *Fly Like a Butterfly* by Shakta Kaur Khalsa

Book: *Yoga for Teens* by Thia Luby

Article: Kaley-Isley LC, Peterson J, Fischer C, Peterson, Yoga as complementary therapy for children and adolescents: a guide for clinicians. *E. Psychiatry (Edgmont).* 2010 Aug; 7(8): 20–32.

CHAPTER NINETEEN

YOGA THERAPY FOR GERIATRICS

S TELLES • N SINGH • N PATEL

Introduction

As the population of seniors increases worldwide, there is a corresponding increasing interest, on the part of both health care providers and seniors themselves, in improving their physical, emotional, intellectual, and even spiritual health through nonpharmacological lifestyle practices and behavioral strategies. All these aspects of life in seniors can be positively impacted by yoga.

Pathophysiology and etiology of aging

Multiple theories explain the basis of biological, psychological, and sociological aging. A plausible theory is the evolutionary basis of senescence. In evolutionary terms, a successful lifespan is one in which an individual organism reaches reproductive age, procreates, and cares for its offspring until they are self-sufficient (Rose & Graves, 1989; Kirkwood & Rose, 1991). Kirkwood (1996) proposed three categories of genes involved in senescence: (1) genes that regulate somatic maintenance and repair, (2) negatively pleiotropic genes that enhance early survival but are harmful later on, and (3) harmful late-acting mutations. Therefore, the post-reproductive physiological status of an organism is an epigenetic and pleiotropic manifestation of the optimization of early fitness. External factors such as free radicals can accelerate aging by genetic changes, whereas removal of oxidative stress can delay it. Calorie restriction and dietary antioxidants that influence oxidative stress also possibly influence cellular aging. Yoga practice involves a change in lifestyle that is believed to reduce oxidative stress and hence positively impact cellular aging (Lavretsky et al., 2013). Hence yoga may influence aging at different levels ranging from the cellular level to mental state (see Table 19.1 , p. 432).

Prevalence

Globally, people aged 60 years or over (seniors) increased from 9.2% in 1990 to 11.7% in 2013 and will continue to increase as a proportion of the world population, reaching 21.1% by 2050 (United Nations Population Division, Department for Economic and Social Information, 2013). This represents more than a doubling of the number of seniors, from 841 million people in 2013 to more than 2 billion in 2050. Presently, about two-thirds of the world's seniors live in developing countries. Since the older population there is growing faster than in more developed regions, projections show that seniors will be increasingly concentrated in the less developed regions of the world; by 2050, nearly 8 in 10 of the world's older population will live in these regions (United Nations Population Division, Department for Economic and Social Information, 2013). Population aging has major social and economic consequences. Given the high and growing prevalence of noncommunicable diseases and the increase in disability as populations age (Wang, Du, Zhai, & Popkin, 2007), there is a need for strategies to cope with this societal burden.

Psychophysiological rationale for the use of yoga in aging

Research on aging has provided information about physical changes that occur with increasing chronological age. These changes include, among others, changes in cardiovascular structure (Di Bello et al., 1993), a slow progressive decline in body mass (Bray, 1979), and a decrease in the strength of muscle mass (Reed, Pearlmutter, Yochum, Meredith, & Mooradian, 1991). Data suggest that these physical decrements may contribute to a reduction in the overall quality of life of the older adult population (Buchner, Larson, Wagner, Koepsell, & DeLateur, 1996).

However, many age-related changes respond reasonably well to an intervention such as yoga, which involves a whole systems approach, in that it involves modification at the level of physical activity (e.g., diet, exercise), mental and emotional activity, social interactions, and, potentially, the spiritual dimension of life.

A rationale for the use of yoga to address the age-related changes includes the benefits of yoga practice for a variety of characteristics, including cardiovascular, musculoskeletal, cognitive, psychosocial, and spiritual functioning, among others. For example, Spina et al. (1993) found that the older adult who has maintained an active lifestyle typically presents with a lower maximal heart rate and a significantly larger stroke volume compared to a sedentary person. Yoga practice, especially the physical postures (asanas) and breathing techniques (pranayamas), has a favorable impact on cardiac function (Bhavanani, Ramanathan, Balaji, & Pushpa, 2014).

The older adult is at greater risk for a variety of fractures due to a reduction in bone-mineral density. However, much like the muscular system, the skeletal system responds fairly well to regular physical activity. Here also the physical aspects of yoga practice, especially the physical postures and breathing techniques, have been observed to improve the outcome in persons with low bone-mineral density (Phoosuwan, Kritpet, & Yuktanandana, 2009).

Cognitive decline, particularly loss of memory associated with aging, is a major concern (Gothe, Kramer, & McAuley, 2014). The areas of cognition most likely to show age-related decrements are declarative or episodic memory and mental processing skills such as perceptual speed. However, there is growing evidence to support the idea that neural plasticity continues across the lifespan, suggesting that cognitive and physical stimulation help to maintain perceptual and memory skills in seniors (Smith et al., 2009). The cognitive component of yoga, which involves understanding and incorporating universally applicable principles, encourages active thought, discrimination, and self-enquiry and keeps the practitioner cognitively engaged (Ramdev, 2008). Depressive illness in older adults is an example of a common spectrum of psychiatric symptoms in late life, which are often under-diagnosed (Shahidi et al., 2011). Depression in the elderly may be due to financial difficulties, loneliness, or feeling unwanted and no longer useful, among other reasons (Manjunath & Telles, 2005) and can also be caused by medical conditions or be a response to physical illness (Weintraub, Furlan, & Katz, 2002). Various forms of psychotherapy and psychological interventions are effective in older adults (Pinquart & Soerensen, 2001). Yoga practice includes certain philosophical principles that have been found to reduce depression in seniors (Krishnamurthy & Telles, 2007). Maintaining emotional stability, having an adaptive coping style, and being actively engaged with life are intrinsic factors of successful aging (Rowe & Kahn, 1998; Vaillant, 2002). Many of these factors are part of a yoga lifestyle, which increases emotional stability (Reva, Pavlov, Loktev, Korenyok, & Aftanas, 2014) and improves cognitive flexibility as well as emotional resilience (Khalsa, Hickey-Schultz, Cohen, Steiner, & Cope, 2012).

Another important factor is social support. The relationship between social support and health has been of interest for many years. Data from a sample of 2,829 non-institutionalized people aged 55–85 years showed that having fewer feelings of loneliness and greater feelings of mastery were directly associated with a reduced mortality risk, when other possible factors were controlled for (Penninx et al., 1997). In addition, people who received a moderate level of emotional support and those with high levels of emotional support had reduced mortality risks compared to those with low levels of emotional support. The interaction between disease status and social support or personal coping resources on mortality was not discussed. Yoga practice, including yoga philosophy, helps to keep seniors engaged, especially if they participate in classes for seniors (Ramdev, 2008).

There is an important connection between spirituality and late-life health. On the positive side, spiritual activities predict longevity. For example, in a meta-analysis analyzing 29 articles, researchers concluded that individuals who scored higher on measures of religious involvement were almost 30% less likely to have died during the period represented by the study than those scoring lower on religious involvement measures, even after accounting for health, gender, race, health-related behavior, and social support (McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000). (It is unclear here whether “religious” refers to faith in a specific belief system and adherence to its requirements or whether it is used in a broader sense of “spirituality,” or being aware of a universally beneficent power beyond our usual experience of ourselves.)

Review and analysis of the published research

The following databases were searched using the words “yoga and older adults” and “yoga and the elderly”: Medline/PubMed, PsycInfo, CINAHL, Web of Science and Scopus. This yielded 28 publications, out of which we included in this review studies that had participants aged 55 years or more, were randomized controlled trials (RCTs), and were in English. Eight articles were excluded because six did not report the effect of yoga, which was a minor component among other interventions, and two were review articles. Hence, 20 articles published between 1950 and 2015 were reviewed. The majority of publications described the effect of yoga on healthy seniors. However, there was one study in cancer survivors, one in patients with chronic obstructive pulmonary disease (COPD), and two in seniors with coronary heart disease.

Five studies assessed the effects of different types of yoga on balance in older adults. A single-blinded pilot RCT on 54 community-dwelling seniors assessed balance through standard tests (Tiedemann, O’Rourke, Sesto, & Sherrington, 2013). Participants were assigned to an Iyengar yoga group and an education for fall prevention. The yoga group improved compared to the control on standing balance, sit-2-stand test, 4-minute walk, and one-legged stand with eyes closed. Studies on community-dwelling seniors have the disadvantage that the findings may not be extrapolated to those living at home. Because there was no alternate intervention, the lack of contact with an instructor in the control group may have given the participants less psychological support. The outcome measures comprehensively evaluated balance and falls. The study design was rigorous, and perhaps the only shortcoming was the lack of an alternate intervention. In another study, three interventions (tai chi, standard balance training, or yoga) were given for 12 weeks (Ni et al., 2014). The participants were seniors who were living independently and had a history of having fallen at least once in the previous year. The yoga (vinyasa style) was an especially designed balance program while the tai chi focused on postural alignment and hand–eye coordination. Hence, both study interventions focused on improving balance, which made them capable of comparison with the control intervention. Participants were assessed on the 8-foot up-and-go test, one-legged stand, functional reach, and usual and maximal walking speed. Static and dynamic balance were assessed by postural sway and dynamic posturography, respectively. Yoga was found to be as effective as tai chi and standard balance training after 12 weeks for different aspects of postural stability. The study had an adequate sample size and was well designed with the specific aim of testing a yoga program intended to improve balance on appropriate measures.

Tai chi and yoga were applied as interventions in a pilot study that assessed balance and falls in institution-dwelling frail seniors (Saravanakumar, Higgins, van der Riet, Marquez, & Sibbritt, 2014). The 30 participants were randomized to three groups (yoga, tai chi, or standard care). After 14 weeks, the yoga group showed a slight decrease in incidence of falls. There was no reported difference in balance measured using the Berg Balance Scale. The two active interventions (tai chi, yoga) were modified to make them suitable for frail seniors. Although the study was a three-armed RCT, its main drawback was the small sample size (*n* = 11, each group).

Balance has also been assessed in older adults with osteoarthritis (Park, McCaffrey, Newman, Cheung, & Hagen, 2014). Thirty-eight participants were assigned to two interventions: Sit 'N' Fit Chair Yoga or a health education program with no active intervention. The yoga program was especially designed for older adults with osteoarthritis who are unable to stand for the practice. At the end of 8 weeks, participants were assessed with the McGill Pain Questionnaire, gait speed test, 6-minute walk test, Berg Balance test, Geriatric Depression Scale (GDS), and the Life Satisfaction Index for the Third Age. At the end of 12 weeks, there was a significant decrease in gait speed and improvement in balance in both groups. The assessments evaluated gait, balance, and psychological well-being. Although the study was well designed, the small sample size (*n* = 11 in one group) is a limiting factor. In a single-masked rigorously conducted RCT, 118 women with kyphosis with an angle of 40 degrees or greater were randomized to two groups (yoga and a control group with modest contact and interaction but no active intervention) (Greendale, Huang, Karlamangla, Seeger, & Crawford, 2009). Kyphosis angle, standing height, timed chair stand, functional reach, walking speed, kyphosis index, Rancho Bernardo Blocks posture, and health-related quality of life were assessed at baseline and after 6 months of intervention. The yoga group showed significantly greater improvement in flexicurve kyphosis angle and kyphosis index when compared with the control group. The participants all had adult-onset hyperkyphosis, which made them less comparable with other older participants assessed for balance. Some minor adverse effects of yoga (i.e., back pain, muscle cramps) were reported.

Of the three studies that assessed physical and emotional well-being and quality of life, the earliest study evaluated 101 seniors randomly assigned to three conditions, namely, aerobic exercise, yoga, or a waitlist control (Blumenthal et al., 1989). This was a comprehensive study with adequate-to-good sample size incorporating assessment of a variety of both physiological (cardiovascular, lipids, cardiorespiratory functioning) and psychological (mood, well-being, memory, psychomotor and psychosocial functioning) measures. Although the focus of this study was on the aerobic exercise intervention, and the yoga intervention was applied as an active control treatment, the authors reported that after 4 months the aerobic exercise and yoga groups perceived themselves as changing on a number of important psychological, social, and physical dimensions. In the physical area, subjects felt in better health; that they looked better; and that they had more energy, endurance, flexibility, and better sleep. Socially, subjects reported improved family relations, better sex life, less loneliness, and a better social life. Psychologically, subjects reported improved mood, self-confidence, and life satisfaction and that they had better memory and concentration. In contrast, the waitlist control group perceived relatively little change over 4 months.

A cluster-randomized trial of 139 senior adults assigned to silver yoga or control groups showed more clear results compared to the study cited above (Chen et al., 2009). Six months of silver yoga improved the self-reported sleep quality, mood, and health status. The participants were community-dwelling seniors (which limits a wider application of the study). Although the sample size was adequate in this trial, there was no alternate active control intervention in the study design, which may be especially important when assessing psychological well-being in community-dwelling seniors. The other study that assessed physical and emotional well-being and quality of life in seniors examined the effect of adherence to a mind–body intervention (Flegal, Kishiyama, Zajdel, Haas, & Oken, 2007). In this three-armed trial, the three assigned conditions were Iyengar yoga with home practice, exercise with home practice, and a waitlist control group. The aim of this study differed from the two described above, in that evaluation of psychological well-being following a yoga intervention was not the aim of the study. This study was an attempt to assess factors that predict adherence to a mind–body intervention. On the whole, the study did not demonstrate clear effects of adherence on the significant study outcomes (quality of life and physical measures).

Three RCTs studied the effect of yoga on respiratory functions of older adults. In a study that evaluated the effect of yoga on older adults with COPD (Donesky-Cuenco, Nguyen, Paul, & Carrieri-Kohlman, 2009), 29 participants were randomized to two groups (a 12-week yoga program specially designed for people with COPD or usual care). The participants were assessed for dyspnea intensity (DI), dyspnea-related distress (DD), physical performance, psychological well-being, and health-related quality of life (HRQOL). After 12 weeks of the intervention the yoga group showed greater improvement in DD, 6-minute walk, and self-reported functional performance compared to usual care. The participants' activities of daily living were limited by dyspnea. The Iyengar yoga intervention was specially developed for individuals with COPD by a panel of yoga instructors and included the use of assisting props. The study's emphasis was on COPD symptoms rather than age-related changes in the respiratory system. A study limitation was the absence of an alternate active control intervention comparison group.

Another study randomized 36 elderly normal healthy women to two groups (yoga and a no-treatment control) whose aim was to evaluate possible improvements in respiratory function including respiratory volumes and respiratory muscle strength with yoga practice (Bezerra et al., 2014). Maximal inspiratory and expiratory pressure (MIP and MEP), tidal volume (VT), vital capacity (VC), minute ventilation (VE), respiratory rate (RR), and heart rate (HR) were assessed before and after 12 weeks of intervention. After the intervention there was a reduction in HR and RR and a significant increase in VE, VC, MIP, and MEP in the yoga group. The yoga program was graded and included both yoga postures and yoga breathing techniques intended to improve respiration. In a third study, which was well-designed and rigorous, the effect of inspiratory threshold training (ITT) and yoga respiratory training (YRT) consisting of yogic breathing exercises was studied in 81 frail older adults (Cebrià i Iranzo, Arnall, Izgual Camacho, & Tomás, 2014). The participants were randomized to three groups (ITT, YRT, or no-treatment control). Participants were assessed for MIP, MEP, and maximum voluntary ventilation (MVV) at four time points: pre-training, mid-training, posttraining, and a follow-up at 3 weeks posttraining. The YRT group showed greater increase of respiratory muscle strength (MIP and MEP) and endurance compared to the control and ITT groups. Most of the participants spent their time seated or lying down and were only able to walk short distances, as per the entry criterion of the inability to independently walk more than 10 minutes. The findings suggest the importance of yoga breathing practice in improving lung function and respiratory muscle function, even in seniors with compromised respiratory functions. Altogether, the three studies described above suggest that yoga practices are capable of improving respiratory variables in older adults with or without respiratory disorders.

Two RCTs and one controlled but not randomized trial found yoga to be beneficial for reducing depression in older adults. In one RCT, 70 elderly women with depression were randomized to three groups (laughter yoga therapy, exercise therapy, and control) (Shahidi et al., 2011). The participants were assessed for depression using the GDS and for life satisfaction using the Satisfaction with Life Scale (SWLS). Practicing 10 sessions of laughter yoga led to greater improvement in depression scores (i.e., lower depression) and life satisfaction scores compared to the control group. Laughter yoga included deep exhalations during chanting synchronized with movements, speaking gibberish, and actual forced artificial laughter "for no reason" in order to initiate and support genuine laughter. The changes in respiration (increased depth, prolonged exhalation) are believed to assist in the laughter initiation, but may by themselves also contribute to the outcome. Laughter yoga may be considered useful for late-life depression, because it includes deep breathing, prolonged exhalations, and a positive mental state.

In another RCT, 69 older adults were stratified and randomized to three groups (yoga, ayurveda, and waitlist control group) (Krishnamurthy & Telles, 2007). Depression was assessed using the GDS at three time points (prior to intervention, after 3 months, and 6 months post-intervention). The yoga group alone showed significant reduction in depression scores at 3 and 6 months**.** The participants were community-dwelling older adults who lived in shared accommodation, which the participants were not accustomed to. They had scores suggestive of severe depression at baseline. Yoga consisted of two sessions (75 minutes per day, which included asanas, pranayamas, guided relaxation, and a devotional session). Participants mentioned that they appreciated the devotional session the most, because it gave them a better acceptance of their situation. The sampling was age stratified, but the wide age range (60 to 94 years) is a design limitation of the study, although it does suggest the usefulness of yoga for late-life depression over a wide age range. The third study (Park et al., 2014) reported lower depression scores in 38 seniors with osteoarthritis assigned to a Sit ‘N’ Fit chair yoga intervention as compared to a health education control. However, there was no difference between groups in their pre- to posttreatment changes in gait speed, balance, and chronic pain. The authors concluded that the yoga program provided more psychological benefits than physical.

The effect of yoga on physical functions, stiffness, and flexibility was evaluated in two RCTs. In a study on seniors with diagnosed osteoarthritis (pain present for at least 15 days each month) and living independently in an assisted-living facility, 29 participants were randomized to three interventions (chair yoga, Reiki, and an educational intervention) (Park, McCaffrey, Dunn, & Goodman, 2011). Pain, stiffness, and physical functions were evaluated using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and depression was measured using the Center for Epidemiologic Studies Depression Scale (CES-D) at the beginning and end of 8 weeks of intervention. Greater improvement in physical functions was found in the chair yoga group compared to the other groups. Chair yoga was also beneficial in reducing pain and stiffness. The chair yoga intervention was found to be both safe and particularly suited to persons with osteoarthritis, because it centered on using the chair for meditation, to “create space” while releasing chronically contracted muscles. In the second study, 204 older adults were recruited from eight senior activity centers and randomized to three groups (complete silver yoga with meditation, shortened silver yoga without meditation, and a waitlist control group) (Chen et al., 2008). The participants were assessed for body composition, cardiorespiratory function, physical function, and range of motion. The results after 24 weeks of intervention indicated that silver yoga improved physical fitness of older adults irrespective of whether it was practiced with meditation. The participants were community-dwelling seniors who were otherwise healthy.

An RCT was conducted on 97 older cancer survivors to assess the effect of yoga on overall cancer-related fatigue (Sprod et al., 2015). The participants had all been diagnosed with cancer, had all received standard treatment (surgery, chemotherapy, radiation therapy, or a combination) in the past, and were randomized to two groups (standard care and standard care with a 4-week yoga intervention called Yoga for Cancer Survivors (YOCAS)). Cancer-related fatigue was assessed using the MFSI-SF and global side-effect burden was assessed using the Clinical Symptom Inventory. The participants in the yoga group had significantly lower total cancer-related fatigue, as well as less physical and mental fatigue, after the intervention as compared to participants in the standard-care group.

Another study reported that Iyengar yoga improved the muscle strength of physically inactive older adults (Vogler, O'Hara, Gregg, & Burnell, 2011). In this study, which incorporated numerous physical and psychological assessments including immune, respiratory, and cardiovascular measures, 38 older adults were randomized to two groups (Iyengar yoga and a control group). Physical health, including muscle strength, active range of motion, respiratory function, resting blood pressure, and immune function were measured. The Life's Odyssey Questionnaire and the Mental Component Summary (MCS) of the SF-12v2 were used to assess mental health and well-being. After 8 weeks of practicing Iyengar yoga, there was a significant improvement in muscle strength, active range of motion, physical well-being, emotional well-being, and self-care. The participants were all residents of a retirement resort and had no specific impairment or need for assisted living. The major study entry criterion was being physically inactive (less than 30 minutes of moderate physical activity per day). These results therefore limit extrapolation of the findings to seniors in general.

The effect of yoga and ayurveda on self-rated sleep in seniors was evaluated in a stratified RCT (Manjunath & Telles, 2005). In this study, 69 older adults were randomized to three groups (yoga, ayurveda, and waitlist control). A questionnaire was used to assess self-rated sleep in the preceding week at baseline and after 3 months and 6 months of the interventions. After 6 months of the yoga intervention there was a significant decrease in the time taken to fall asleep, an increase in the total number of hours slept, and an increased feeling of being rested in the morning. These changes were observed in the yoga group alone. Participants of all groups were in a residential facility with shared accommodation during the study, which could have influenced the quality of sleep. In addition, the authors mention psychological factors such as "leaving a familiar home to live in a supervised setting" as well as "financial strain." Hence these participants differed from those in the previously cited study (Vogler et al., 2011) because they were actively engaged in fears about their financial status. Though the study was otherwise fairly rigorous in terms of the design, sleep was assessed by subjective ratings of the participants and could have been influenced by the psychological factors mentioned above. This is a limiting factor in extrapolating the findings to seniors in general.

One RCT evaluated the effect of yoga practice on cognitive functions of community-dwelling seniors randomized to two active intervention groups (a hatha yoga intervention or a stretching-strengthening control group) (Gothe, Kramer, & McAuley, 2014). Executive functions of working memory and task switching were assessed using E-prime 2.0, running memory was assessed using the letter version of the Running Memory Span test, and working memory was assessed using a modified serial n-back task. Assessments were done before and after 8 weeks of intervention. Participants in the yoga group showed greater improvement in working memory capacity and efficiency of mental set shifting and flexibility compared to the control group. One of the criteria for inclusion was being sedentary for at least 6 months prior to the study. The absence of a no-treatment control group is particularly a disadvantage when assessing neurocognitive assessments (i.e., task switching and working memory capacity), where familiarity with the task could influence the results on retesting. Despite this limitation, the study by Gothe et al. (2014) suggests benefits of yoga for neurocognitive tasks.

Overall, the studies described above demonstrate the benefits of yoga practice in improving the mental state, sleep, respiratory functions, balance, flexibility, and neurocognitive functions in seniors; further details, including possible mechanisms underlying the effects, are given in Table 19.2 (p. 433).

Summary and directions for future research

It is anticipated that the number of seniors worldwide will increase in the coming years. Lifestyle interventions such as yoga offer promise for healthy aging. Future research needs to evaluate the benefits of yoga programs for age-associated conditions (e.g., loss of memory) using more rigorous methods. It is also important to realize that it may be an overall change in lifestyle (involving physical, mental, social, and even spiritual components) that is most effective, rather than specific techniques. In any case, nonpharmacological interventions such as yoga are worthy of investigation for promotion of healthy aging and prevention of disease as a person ages.

Table 19.1 Influence of yoga on aging at different levels

Levels				
Cellular	***Tissues***	***Organs***	***Systems***	***Mental health***
Reduction in stress-related cellular aging by increasing telomerase activity (Lavretsky et al., 2013) Meditation can reduce aging-accelerating effects of chronic inflammation and related immune processes (Bushell & Thiese, 2009) The leukocyte telomerase length is better preserved in regular yoga practitioners as compared to sedentary individuals (Krishna et al., 2015)	Holding static postures in *asanas* can increase muscle strength, increase in length of both connective and muscle tissue due to stretching can reduce stiffness (William & Goldspink, 1973) Yoga can increase flexibility of the hamstring muscles (Grabara & Szopa 2015)	*Baroreflex sensitivity:* Age-associated reduction in baroreflex sensitivity is modifiable by yoga practice (Bowman et al., 1997) *Insulin resistance:* Practicing yoga may reduce insulin resistance syndrome-related risk factors for cardiovascular disease (Innes et al., 2005) *Arterial flexibility:* Yoga can reduce arterial stiffness (Duren et al., 2008) *Heart:* Yoga can improve heart rate variability (Santaella et al., 2011) Yoga reduces age-related deterioration in cardiovascular functions (Bharshankar et al., 2003) *Lungs:* Yoga can improve lung function (Santaella et al., 2011) *Liver:* Practicing yoga can increase high density lipoprotein (Ramos-Jimenez et al., 2009)	*Cardiovascular:* Practicing yoga increased Wmax by 21%, with a significantly reduced level of oxygen consumption per unit work but without a concomitant significant change in heart rate (Raju et al., 1997)	Yoga can improve quality of life (Hariprasad et al., 2013) Increased yoga experience predicted increased levels of psychological well-being (Moliver et al., 2013) Brief daily meditation practices can lead to improved mental and cognitive functioning and lower levels of depressive symptoms (Lavretsky et al., 2013) Yoga practice can reduce both state and trait anxiety (Gururaja et al., 2014)

	Brain: Vipassana meditation helps to establish a proper sleep structure in old age (Pattanashetty et al., 2010) Meditation may reduce the risk for cerebrovascular disease and age-related neurodegeneration, may potentially strengthen neuronal circuits and enhance cognitive reserve capacity and may lower age-related decline in thickness of specific cortical regions (Xiong & Doraiswamy, 2009) Meditation can prevent age-related cognitive decline (Prakash et al., 2012) Yoga may increase hippocampal gray matter (Hariprasad et al., 2013)	

Wmax: maximal work output.

Table 19.2 Possible mechanisms involved in the 20 studies reviewed

Sl. No.	Systems involved	Variables measured	Nature of change	Possible mechanisms involved according to the authors of the present review	Citation
1	Balance	Standing balance, Sit-2-Stand test, 4-m walk and one-legged stand with eyes closed	The yoga group improved compared to the control on standing balance, Sit-2-Stand test, 4-m walk and one legged stand with eyes closed	Increased muscle strength and endurance (Wolfson et al., 1995) and better integration of signals from vestibular and somatosensory systems (Anderson et al., 2005)	Tiedemann et al., 2013
2	Balance	8 ft up-and-go test, one legged stand, functional reach and usual and maximal walking speed, static and dynamic balance were assessed by postural sway and dynamic posturography respectively	Yoga was found to be as effective as tai chi and standard balance training in different aspects of postural stability	Increased muscle strength and endurance (Wolfson et al., 1995) and better integration of signals from the vestibular and somatosensory systems (Anderson et al., 2005)	Ni et al., 2014
3	Balance	Balance and fall	The yoga group showed a slight decrease in incidence of falls	Yoga practice can improve reaction time (Madanmohan et al., 1992), increase muscle coordination and integration of signals from the vestibular and	Saravanakumar et al., 2014

				somatosensory systems and visual inputs (Anderson et al., 2005)	
4	Balance	Pain, gait-speed test, 6-minute walk test, balance, depression, life satisfaction index for the third age	There was a significant decrease in gait speed, and improvement in balance in both groups	Increased muscle strength (Wolfson et al., 1995), joint mobility (Ebnezar et al., 2012) and muscle coordination and integration of signals from the vestibular and somatosensory systems and visual inputs (Anderson et al., 2005)	Park et al., 2014
5	Balance	Kyphosis angle, standing height, timed chair stands, functional reach, walking speed, kyphosis index, Rancho Bernardo Blocks posture, and health-related quality of life	The yoga group showed significantly greater improvement in flexicurve kyphosis angle and kyphosis index when compared with the control group	Holding static postures in *asanas* can increase muscle strength; increase in length of both connective and muscle tissue due to stretching can increase flexibility of the spine (William & Goldspink, 1973)	Greendale et al., 2009
6	Physical and emotional well-being and quality of life	Blood pressure, lipids, bone density, cardiorespiratory fitness, mood, psychiatric symptoms, and neuropsychological functioning	No clear benefits of practicing yoga in older persons	Multifactorial; difficult to speculate the mechanism of change	Blumenthal et al., 1989

7	Physical and emotional well-being and quality of life	Self-reported sleep quality, mood, and self-reported health status	Practicing silver yoga improved the self-reported sleep quality, mood, and self-reported health status	Decreased physiological arousal (Sarang et al., 2006), increased thalamic GABA levels (Streeter et al., 2010) and other mood enhancing hormones	Chen et al., 2009
8	Physical and emotional well-being and quality of life	Physical and emotional well-being and quality of life	Reports of quality of life and self-reported physical and emotional well-being were inadequate	Multifactorial; difficult to speculate the mechanism of change	Flegal et al., 2007
9	Respiratory functions	Dyspnea intensity, dyspnea-related distress, physical performance, psychological well-being, and health-related quality of life	The yoga group showed greater improvement in dyspnea-related distress, 6-minute walk, and self-reported functional performance compared to usual care	Increased respiratory muscle strength (Madanmohan et al., 1992), reduction in emotional (Aftanas et al., 2005) and physiological arousal (Sarang et al., 2006)	Donesky-Cuenco et al., 2009
10	Respiratory functions	Maximal inspiratory and expiratory pressure, tidal volume, vital capacity, minute ventilation, respiratory rate, and heart rate	After the intervention there was a reduction in heart rate and respiratory rate in the yoga group. A significant increase in VE, VC, MIP and MEP was	Increased respiratory muscle strength (Madanmohan et al., 1992), reduction in emotional (Aftanas et al., 2005) and physiological arousal (Sarang et al., 2006)	Bezerra et al., 2014

			observed in the yoga group		
11	Respiratory functions	Maximal inspiratory and expiratory pressure and maximum voluntary ventilation	The YRT group showed greater increase of respiratory muscle strength (MIP and MEP) and endurance compared to the control and ITT groups	Increased respiratory muscle strength (Madanmohan et al., 1992)	Cebrià i Iranzo et al., 2014
12	Depression	Depression and life satisfaction	Practicing laughter yoga led to greater improvement in depression scores (i.e., lower depression) and life satisfaction scores compared to the control group	Reduction in cortisol level (Thirthalli et al., 2013), anxiety and stress (Telles et al., 2009)	Shahidi et al., 2011
13	Depression	Depression	The yoga group alone showed significant reduction in depression scores	Improvement in integration of brain areas (Gard et al., 2014), better psychosocial reappraisal, and regulation of autonomic nervous systems (Kinser et al., 2012)	Krishnamurthy & Telles, 2007
14	Depression	Pain, gait-speed test, 6-minute walk test, balance, depression, life-satisfaction index for the third age	Reported lower depression scores in 38 older persons with	Improvement in integration of brain areas (Gard et al., 2014), better psychosocial	Park et al., 2014

			osteoarthritis assigned to either Sit-N-Fit chair yoga or a health education program	reappraisal and regulation of autonomic nervous systems (Kinser et al., 2012)	
15	Physical functions, stiffness and flexibility	Pain stiffness and physical functions	Greater improvement in physical functions was found in the chair yoga group as compared to other groups. Chair yoga was also beneficial in reducing pain and stiffness	Holding static postures in *asanas* can increase muscle strength; increase in length of both connective and muscle tissue due to stretching can reduce stiffness (William & Goldspink, 1973)	Park et al., 2011
16	Physical functions, stiffness and flexibility	Body composition, cardio-respiratory functions, physical functions, and range of motion	Silver yoga can improve physical fitness of older adults irrespective of whether it is practiced with meditation	Increased muscle strength and endurance (Wolfson et al., 1995) and better cardio-pulmonary gaseous exchange (Telles et al., 2000)	Chen et al., 2008
17	Cancer	Cancer related fatigue and global side-effect burden	The participants in the yoga group had significantly lower total cancer-related fatigue, as well as physical and mental fatigue after the intervention	Yoga can reduce arousal (Sarang et al., 2006), reduce inflammation (Bower et al., 2014), and improve hypothalamic–pituitary–adrenal axis regulation (Ross et al., 2010)	Sprod et al., 2015

			compared to participants in the standard care group		
18	Muscle strength	Muscle strength, active range of motion, respiratory function, resting blood pressure, immune function, mental health and well-being	Practicing Iyengar yoga can significantly improve muscle strength, active range of motion, physical well-being, emotional well-being, and self-care.	Increase in length of both connective and muscle tissue due to stretching (William & Goldspink, 1973), decreased physiological arousal (Sarang et al., 2006), increased thalamic GABA levels (Streeter et al., 2010) and other mood-enhancing hormones	Vogler et al., 2011
19	Sleep	Self-rated sleep	Yoga intervention can significantly decrease the time taken to fall asleep, increase the total number of hours slept, and increase feeling of being rested in the morning. These changes were observed in the yoga group alone	Reduce physiological arousal (Sarang et al., 2006), practicing yoga can improve neurologic sleep-regulating mechanisms including GABA (Streeter et al., 2010) and melatonin (Harinath et al., 2004)	Manjunath & Telles, 2005
20	Cognitive functions	Executive functions of	Participants in the yoga group	Yoga can improve attention	Gothe et al., 2014

	working memory and task switching was assessed	showed higher improvement in working memory capacity and efficiency of mental set shifting and flexibility compared to the control group	(Telles et al., 2013), enhance mood (Reed, 2014) and promote self-control and awareness (Gard et al., 2014)	

GABA: gamma-amino butyric acid; ITT: inspiratory threshold training; MEP: maximal expiratory pressure; MIP: maximal inspiratory pressure; VC: vital capacity.

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Geriatrics: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Although yoga practices are often modified to reflect the increased frailty and chronic medical conditions present in many elderly people, some long-term practitioners of yoga continue to practice advanced asana well into their eighth and ninth decades (see Fig. 19.1). Common findings that Ganesh Mohan has observed among older students that may necessitate adaptations in their yoga programs include “a decrease in balance, loss of muscle strength, diminished coordination and speed of movement, reduced body awareness, osteoporosis and risk of fracture, tendency toward stooped posture and stiffness, osteoarthritis and musculoskeletal aches and pains, possible decline in cognitive function and memory, and reduced cardiorespiratory capacity.”

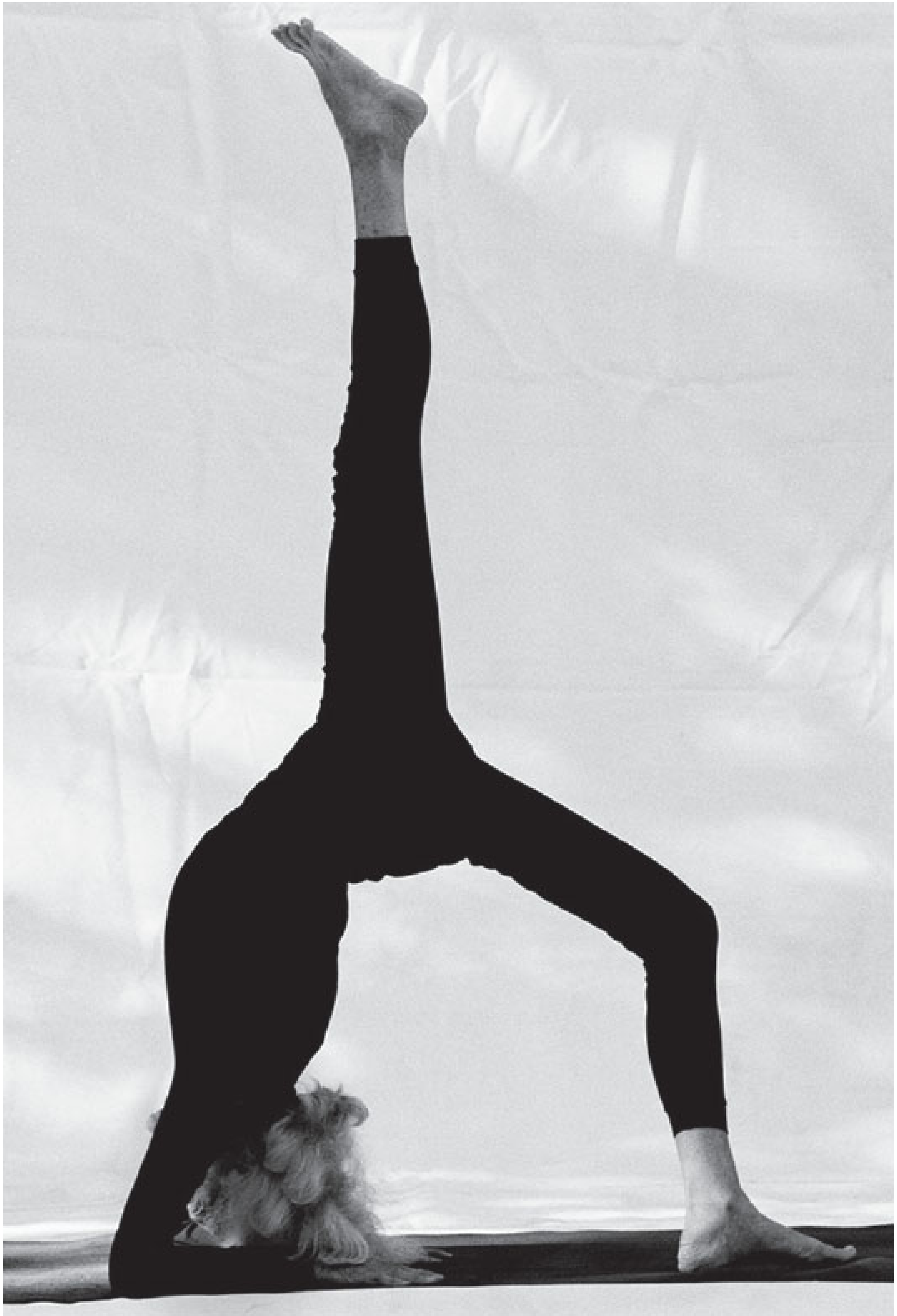

Figure 19.1

Vanda Scaravelli, the grandmother of this book's co-editor Lorenzo Cohen, practicing an advanced backbend in her 80s.
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In addition, Carol Krucoff says, "Regardless of specific ailments an older adult is facing, there also tend to be imbalances just from the mere fact of being at an advanced age. These include sleeping difficulties, poor eyesight and hearing, slowed gait, and reduced functional status. Related issues include dealing with losses—of profession, loved ones, physical functioning."

Jnani Chapman says, "Many elders have multiple chronic illnesses like hypertension, type 2 diabetes, arthritis, and osteoporosis." Mohan says, "These concomitant health problems can limit the possibilities of what we can do when we are older. For instance, inversions may be contraindicated, and many deeper stretches and strenuous asanas will be ruled out." Krucoff says, "Practices that have an easeful, fluid quality of motion, rather than forceful, jerky and/or high impact movements, are likely to be safer." Mohan says, "Also, being cautious with breath holding and straining is wise."

"Even relatively gentle inversions," says Krucoff, "such as legs-up-the-wall pose (*viparita karani*), could be problematic for certain elderly people with specific ailments," for example, someone with congestive heart failure and peripheral edema. "Using less of an incline—such as having the legs elevated on a pillow or possibly a chair—may be a useful modification."

"If the person is chair bound," says Mohan, "I tend to start with breathing exercises and chair sequences, emphasizing axial extension and trunk mobilization. If standing is possible, I would start with arm raises and mini squats, gradually working toward warrior, triangle, and rotated-triangle poses with increasing distance between the feet. I would limit trunk flexion and forward folding in these asanas according to safety and the student's capacity. Stepping patterns (forward, sideways, backward, diagonal) can be integrated into this modified warrior sequence. I would include some breath awareness exercises in the asana practice, which would lead to simple pranayama to conclude; this might even be just seated breath awareness." He adds that "if the person is open to it, I might include chanting a mantra aloud, probably along with the asana practice."

Chapman says, "The yoga therapist needs to offer repetitive movement routines that can get circulation into fingers and toes, wrists and ankles, elbows and knees, and shoulders and hips. Appropriate joint range-of-motion stretches can help maintain function and reduce degeneration." While generally in yoga one tries to avoid any postures that cause pain, Mohan says that he "encourages extending the range of movement as far as reasonably pain free in osteoarthritis to maintain ambulation and thus independence as well."

"Breathing practices—in particular the relaxed abdominal breath and the three-part breath—help provide a stable foundation emotionally, physically, and spiritually," says Krucoff. "Gentle asana practice can be useful in improving posture and helping to maintain and increase function of joints and muscles. Meditation—particularly mindfulness and guided relaxation—is a useful skill for dealing with anxiety and other emotional upset" (see Fig. 19.2). Mohan believes that regular mantra meditation can "help maintain mental focus and maybe cognitive function.” In addition, he often recommends “chanting and use of sound to improve breathing and lung capacity, and for speech clarity as well as help with swallowing.”

Chapman says, “Some people have sleep issues as they age. The relaxation practices like *yoga nidra* can provide a deeply restful and restorative experience.” A teacher can guide this in person, make a recording for the student, and several commercial recorded versions are available. “After being guided many times,” she says, “many elders can guide themselves into this relaxation state when sleep is elusive.”

Figure 19.2

A regular meditation practice may facilitate emotional stability and help maintain mental focus in older yoga practitioners. (Vanda Scaravelli in padmasana.)

Reproduced with permission from Rob Howard

”Fall prevention is a top priority with elders,” Chapman says. She often begins with basic chair and floor stretches, which she says help to develop balance and coordination. Holding the back of a chair for support is a good way to introduce standing poses when it is safe to do so. Mohan says, “Props for support in standing postures can be particularly useful, like the wall, a table, or a heavy chair.” Chapman adds, “Props for seated or lying-down postures need to be soft and cushioning. They need to offer support but still be comfortable. Hard bolsters and sticky mats on hard wood floors,” she says, can be problematic for this population, “because they will have a hard time relaxing if they do not feel comfortable.”


A
B

Figure 19.3

(A) Toe flings and (B) toe curls may improve mobility in the feet and balance.

Reproduced with permission from Carol Krucoff, NC, USA

Tree pose (*vrksasana*) is one asana that Krucoff often recommends to improve balance. She instructs students to do this pose "lightly touching a countertop, wall, or chair back for support if you like. Find a fixed spot at eye level to focus your gaze, as this can help stabilize your balance." Another way to improve balance, she says, is to keep the feet supple and mobile. She often recommends toe flings and toe curls (see Fig. 19.3 A, B). "Sit tall in seated mountain pose," she tells students, "and slide your heels forward. Lift your toes and the balls of your foot. Spread your toes out as wide as you can—with no toe touching another toe if possible. Don't worry if your toes don't spread that wide, just do your best. Then, curl your toes in, as if you were making a 'foot fist,' fling your toes out, then fist your toes in. Continue for several rounds—making sure that you are not holding your breath."

Krucoff says, "As osteoporosis tends to be extremely common among the elderly, avoiding positions that could increase risk of fracture is essential. These include loaded forward flexion, loaded rotation, and end-range rotation. To modify, 'take a load off,' that is, do the pose in an unloaded (lying down) or less-loaded (standing) position. Avoid impact and keep the quality of motion gentle."

Beyond practicing yoga at home—a vital element of most yoga therapy prescriptions—an additional goal, according to Chapman, "is to create a sense of community." For this reason, she says, "group classes are useful and perhaps even essential with elders. This community of people who care and listen is crucial with this population because it helps to counter the experience of isolation."

Resources

Book: *Relax into Yoga for Seniors* by Carol Krucoff and Kimberly Carson

Video: *Relax into Yoga for Seniors* by Carol Krucoff and Kimberly Carson

Article: Krucoff C, Carson K, Peterson M, Shipp K, Krucoff M., Teaching yoga to seniors: essential considerations to enhance safety and reduce risk in a uniquely vulnerable age group. *The Journal of Alternative and Complementary Medicine* 2010; 16 (8): 899–905.

CHAPTER TWENTY

YOGA THERAPY FOR OBSTETRICS AND GYNECOLOGY

C BOOTH-LAFORCE • L TAYLOR-SWANSON • R NAGARATHNA • R CHAKU

Introduction

In this chapter, we review research about yoga treatment for a number of aspects of women's health, including menopause, menstruation, pregnancy, and polycystic ovarian syndrome (PCOS). Some of this research focuses on decreasing symptoms and improving wellness in healthy women experiencing normal transitions (e.g., pregnancy, menopause) while other research focuses on treating atypical conditions or disorders (e.g., PCOS, high-risk pregnancy). We did not include in our review diseases or conditions that affect women primarily but not exclusively (e.g., breast cancer, osteoporosis).

To investigate the scientific literature on yoga for the aforementioned aspects of women's health, we performed an extensive search using PubMed/Medline and CINAHL Plus for yoga research reported in English. For this review, we included only randomized controlled trials (RCTs) and excluded trials of yoga that were combined with other complementary modalities (e.g., one study combined yoga with tai chi). This resulted in the inclusion of 10 publications (six studies) about yoga for menopause, 12 publications (eight studies) about yoga for pregnancy, six publications (five studies) about yoga for menstrual issues, and three publications (one study) about yoga for PCOS (see Table 20.1 , p. 452).

Menopause

Pathophysiology, etiology, and prevalence

All women undergo physiological changes associated with menopause and typically experience a variety of symptoms that impact quality of life. Although the experience of menopausal symptoms varies by culture (Melby, Lock, & Kaufert, 2005), in the United States more than 38 million women who are 45–64 years old (88%) experience menopause-related vasomotor symptoms (daytime hot flashes or night sweats; Williams et al., 2008), which are the most prevalent and bothersome symptoms of menopause. Sleep and mood disturbances, pain, difficulty concentrating, and diminished energy also are common and can have a marked impact on work, leisure, social, and sexual functioning, as well as overall quality of life (Avis et al., 2009; Kravitz et al., 2003; Maki et al., 2008; Williams, Levine, Kalilani, Lewis, & Clark, 2009).

The underlying physiology of vasomotor symptoms is not well understood. Although they have been characterized as heat dissipation events caused by thermoregulatory changes related to reproductive hormone alterations (Freedman, 2005; Randolph et al., 2005), they have also been linked to autonomic nervous system (ANS) activation. Specifically, hot flashes may alter the balance between the sympathetic branch of the ANS (which is responsible for the "fight or flight" response) and the parasympathetic branch of the ANS (which is responsible for restorative functions) (Berntson et al., 1997). In fact, extant evidence has indicated both increased sympathetic activation during hot flashes

(Freedman, Kruger, & Wasson, 2011) and decreased parasympathetic influences (Thurston, Christie, & Matthews, 2010, 2012), as well as subjective experiences of distress and anxiety (Freeman et al., 2005; Gold et al., 2006).

Scientific/physiological rationale for use of yoga

In considering the application of yoga to menopausal symptoms, the primary focus has been on reducing vasomotor symptoms and improving menopause-related quality of life (see Newton et al., 2014; Reed et al., 2014). The physiological basis for the potential effect of yoga on vasomotor symptoms stems from the aforementioned links between these symptoms and increased sympathetic nervous system (SNS) activation and decreased parasympathetic nervous system (PNS) activation. Specifically, yoga practice has been hypothesized to improve medical conditions and symptoms that are exacerbated by stress, in part by increasing activity of the PNS through stimulation of the vagus nerve and thereby balancing the ANS (Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). Data to support these hypothesized links come from several studies showing that yoga practice increases heart rate variability (HRV), suggesting increased vagal tone and decreased sympathetic activity (Khattab, Khattab, Ortak, Richardt, & Bonnemeier, 2007; Papp, Lindfors, Storck, & Wändell, 2013; Patil, Mullur, Khodnapur, Dhanakshirur, & Aithala, 2013).

The scientific literature testing yoga practice as a treatment for various conditions and symptoms is also informative when applied to other common symptoms of menopause (mood disturbances, pain, sleep, difficulty concentrating). For example, Telles and colleagues (Telles, Singh, Yadav, & Balkrishna, 2012) demonstrated that, compared with a control group, those in a brief yoga treatment group experienced significantly improved sleep and quality of life and decreased anxiety and somatization of stress. Similarly, in a randomized waitlist-controlled trial, Halpern et al. (2014) found significant improvements following the yoga intervention in amount and quality of sleep, fatigue, general well-being, depression, anxiety, stress, tension, and anger. In yet another RCT, Michalsen et al. (2012) found similar yoga-related improvements in anxiety, depression, quality of life, mood states, and bodily complaints. Trials of yoga for cognitive functioning are less common, but Gothe, Kramer, and McAuley (2014) did find significant improvement in executive functioning following the yoga intervention, compared with a stretching–strengthening control.

Research summary

Of the six RCTs of yoga for menopause symptoms, one study reported a significant reduction in the frequency of hot flashes in the yoga group compared with the control group (Chattha, Raghuram, Venkatram, & Hongasandra, 2008); one reported no difference between groups (Newton et al., 2014); and one reported a trend in decreased hot flashes in both the yoga and the control group, but the between-group differences were nonsignificant (Avis, Legault, Russell, Weaver, & Danhauer, 2014). Three papers reported significant improvements in the yoga group (compared with control group) on menopause-related quality of life or severity of menopause-related symptoms (Afonso et al., 2012; Joshi, Khandwe, Bapat, & Deshmukh, 2011; Reed et al., 2014).

Several studies included measures of other symptoms experienced by women in the menopausal transition and early postmenopause. These symptoms include insomnia, quality of life, perceived stress, neuroticism, cognitive concerns, positive and negative affect, and pain. Sleep problems such as insomnia were benefited by yoga in three trials (Afonso et al., 2012; Chattha, Nagarathna, Padmalatha, & Nagendra, 2008; Newton et al., 2014). However, Elavsky and McAuley (2007c) did not find significant changes by group (yoga versus walking) in sleep quality.

Decreased stress was associated with the yoga intervention in two trials (Afonso et al., 2012; Chattha et al., 2008b). Other symptoms that improved as a result of yoga interventions included anxiety and depressive symptoms (Afonso et al., 2012) and cognitive concerns (Chattha et al., 2008a). Neither yoga nor a walking intervention improved global or physical self-esteem (Elavsky & McAuley, 2007b), but both interventions improved positive affect (Elavsky & McAuley, 2007a).

Based on this review, yoga shows promise as a therapeutic intervention for women experiencing symptoms during the menopausal transition. First and foremost, yoga appears to be a safe intervention, because no serious adverse events were reported in any of these trials (at least for the trials reporting anything about adverse events). In terms of symptoms, the evidence for an effect of yoga practice on the frequency of hot flashes is equivocal. However, it appears that yoga may be beneficial for improving menopause-related quality of life as well as symptoms related to sleep and mood. It is also noteworthy that none of these publications reported on stress-related physiological changes following yoga treatment, so it is not clear whether the underlying physiological rationale for using yoga to deal with menopausal symptoms was supported.

Menstrual issues: premenstrual syndrome and dysmenorrhea

Pathophysiology, etiology, and prevalence

Premenstrual syndrome

Premenstrual syndrome (PMS) comprises a number of emotional symptoms (such as irritability, tension, and dysphoria), with or without physical symptoms, that occur during the luteal phase of the menstrual cycle. Symptoms may have significant impact on daily activities and quality of life (Hylan, Sundell, & Judge, 1999). A meta-analysis and systematic review of PMS studies worldwide found a pooled prevalence rate of 47.8% (range = 12–98%) (Direkvand-Moghadam, Sayehmiri, Delpisheh, & Sattar, 2014).

The etiology of PMS is uncertain and likely complex. One theory is that women with PMS have an underlying serotonin deficiency, which yields increased sensitivity to progesterone changes during the luteal phase. Other factors may be deficiencies in prostaglandins (Dickerson, Mazyck, & Hunter, 2003), cyclic changes in immunosuppression (Doyle, Ewald, & Ewald, 2007), abnormal hypothalamic–pituitary–adrenal (HPA) axis functioning, and stress (Girman, Lee, & Kligler, 2003).

Dysmenorrhea

Dysmenorrhea is defined as pain during menstruation that interferes with daily activities; typically, it begins in adolescence (Coco, 1999). A comprehensive review of studies, published between 2002 and 2011, concluded that the prevalence of dysmenorrhea varied from 16% to 91% in women of reproductive age, with severe pain in 2–29% of women (Ju, Jones, & Mishra, 2014).

The etiology of primary dysmenorrhea is not completely clear, but the symptoms are most likely related to the release of uterine prostaglandins during endometrial sloughing, which stimulates contractions, ischemia, and sensitization of nerve endings (Coco, 1999). Impaired uterine blood flow throughout the entire menstrual cycle also may play a role (Dmitrovíc, 2000). In a comprehensive review, Ju et al. (2014) found that factors such as age, parity, and use of oral contraceptives were inversely associated with dysmenorrhea, while high stress increased the risk of dysmenorrhea. A study of Korean middle school adolescents showed that stress was one of the major factors that influenced dysmenorrhea apart from their general health status and dietary habits (Jeon, Cha, & Sok, 2014). It has also been found that women with dysmenorrhea have more sensitive physiological responses to stress in the sympathetic–adrenal–medullary (SAM) axis than do women without dysmenorrhea (Park & Watanuki, 2005).

Scientific/physiological rationale for use of yoga

For both PMS and dysmenorrhea, stress responses have been implicated as contributors to symptom expression. As reviewed in the section on menopause, yoga may moderate stress responses by increasing activity of the PNS through stimulation of the vagus nerve and consequent balancing of the ANS (e.g., Streeter et al., 2012). In addition, yoga has been shown to improve general well-being, depression, anxiety, stress, tension, and anger (Halpern et al., 2014), leading to the conclusion that the emotional symptoms frequently experienced as part of PMS could be impacted positively by yoga practice. It is also possible that dysmenorrheic pain could be reduced through yoga-related increases in levels of serotonin and brain-derived neurotrophic factor, which have been shown to mediate perceived levels of pain following a yoga intervention for chronic low-back pain (Lee, Moon, & Kim, 2014).

Research summary

Of the five studies investigating yoga for menstrual issues, only one focused specifically on women with PMS (Sharma, Misra, Singh, Sharma, & Archana, 2013). In this study, women were randomized to an *anuloma-viloma* (alternate-nostril breathing) group, an asana group, or a control group. Women in the two treatment groups had improved postintervention blood pressure, heart rate, respiratory rate, electromyogram, and galvanic skin responses compared with controls, which points to reduced SNS activation. However, changes in PMS symptoms were not studied, so it is not possible to make the hypothesized links between PMS and improvements in the stress response. Two other studies of healthy women who were not selected for the presence of PMS symptoms showed posttreatment decreases in menstrual pain (Sakuma et al., 2012) and improved physiological (heart rate, blood pressure) and psychological (anxiety, depression, anger) characteristics in the yoga versus control groups (Kanojia et al., 2013).

One study was found that focused on yoga for women with menstrual disorders (Monika, Singh, Ghildiyal, Kala, & Srivastava, 2012; Rani et al., 2013), which included dysmenorrhea as well as a variety of other conditions. Women who were provided with a yoga nidra treatment, compared with controls, had decreased levels of thyroid-stimulating hormone, follicle-stimulating hormone, luteinizing hormone, and prolactin (Rani et al., 2013), as well as improved heart rate and blood pressure (Monika et al., 2012) following the intervention. Although these results appear to be positive, the links between changes in hormone profiles and dysmenorrhea are not explained. Finally, one study focused on young women with primary dysmenorrhea and found that those in the yoga group had decreased pain intensity and duration (Rakhshaee, 2011).

Yoga treatment for menstrual issues may be promising, but too few studies have been conducted to draw strong conclusions. Only one study specifically selected women with PMS, one study enrolled women with dysmenorrhea, and one study included women with a variety of menstrual disorders, including dysmenorrhea.

Pregnancy

Pathophysiology, etiology, and prevalence

Pregnancy is a condition affecting multiple millions of women annually, with the current estimated annual worldwide birth rate of 18.7 per 1000 population (World Factbook, 2015). Pregnant women undergo physiological changes that affect physical and psychological functioning throughout gestation, labor, and delivery. Maternal stress and anxiety during pregnancy can have deleterious effects on the fetus's developing brain morphology and nervous system, neonatal stress regulation, and child developmental outcomes (Sandman, Davis, Buss, & Glynn, 2012). In terms of physiological mechanisms, it has been hypothesized that maternal stress responses affect the fetus through decreasing blood flow and oxygen to the uterus and/or increasing activation of the placental stress system, resulting in the circulation of corticotropin-releasing hormone (Fink et al., 2011). In addition, the amount of pain experienced during labor may be related to maternal stress (Alder, Fink, Bitzer, Hösli, & Holzgreve, 2007).

A number of pregnancy complications may increase the probability of negative maternal and perinatal outcomes, and the risk factors for these complications are myriad and complex. Some of the more common disorders are preeclampsia (Maynard, Epstein, & Karumanchi, 2008), intrauterine growth restriction (IUGR) (Mert et al., 2012), gestational diabetes (Gauster, Desoye, Totsch, & Hiden, 2012), and preterm delivery (Behrman & Stith Butler, 2007). Although the prevalence of these complications is higher in developing countries, the worldwide rate of prematurity is about 10% (World Health Organization, 2014); IUGR, 3–7% (Romo, Carceller, & Tobajas, 2009); preeclampsia, 2–8% (World Health Organization, 2011); and gestational diabetes, 3–10% (Moore, 2014). In addition to known biomedical risks, it is likely that maternal stress may play a role in the etiology of at least some of these maternal and fetal disorders (Alder et al., 2007; Mulder et al., 2002).

Scientific/physiological rationale for use of yoga

As reviewed in the sections on menopause and menstrual issues, yoga practice may moderate stress responses at the physiological level, which would likely impact both maternal and fetal outcomes. In addition, yoga may impact well-being and other psychological attributes, as well as increasing the ability to cope with pregnancy-related physical discomforts and labor pain.

Research summary

Of the eight studies investigating yoga treatment for pregnancy, four focused on normal pregnancy. In these studies, yoga treatment (compared with controls) resulted in decreased perceived stress, pregnancy discomfort, anxiety, and depression (Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009); less perceived and observed labor pain and shorter labor duration (Chuntharapat, Petpichetchian, & Hatthakit, 2008); improved quality of life and interpersonal relations (Rakhshani, Maharana, Raghuram, Nagendra, & Venkatram, 2010); reduced sympathetic tone and increased autonomic balance and decreased perceived stress (Satyapriya, Nagarathna, Padmalatha, & Nagendra, 2013); and decreased pregnancy-specific anxiety and depression (Newham, Wittkowski, Hurley, Aplin, & Westwood, 2014).

The four remaining studies focused on women with a variety of symptoms and conditions: pregnancy-related lower-back pain (Martins & Silva, 2014), depression (Field, Diego, Delgado, & Medina, 2013; Field et al., 2012), and high-risk status (due to history of poor obstetric outcomes, twins, extreme age, obesity, family history of poor obstetric outcomes; Deshpande et al., 2013; Jayashree et al., 2013; Rakhshani et al., 2012, 2015). In this diverse group of studies, the results were generally positive. Specifically, women with pregnancy-related lower-back pain experienced decreasing pain over the course of yoga treatment, compared with controls. Among depressed women, Field et al. (2012) found that yoga, compared with standard treatment, resulted in decreased depression, anxiety, anger, back and leg pain, and improved relationship scores; infants had greater gestational age at birth and higher birthweight. However, similar effects were found for women who received the massage treatment, which calls into question the specificity of the effects of yoga practice. In a second study of depressed women, Field et al. (2013) compared yoga treatment with a social support control and found that both groups decreased significantly in depression, anxiety, and anger, increased in relationship quality, and exhibited decreases in cortisol, estriol, and progesterone. Again, this study yielded positive results, but these results suggest that some benefits attributed to yoga may actually be due to the women's feelings of support while engaging in group practice.

In a series of publications about one study of yoga treatment for pregnant women designated as high-risk, the women in the yoga group, compared with a prenatal exercise control group, had less pregnancy-induced hypertension, preeclampsia, and gestational diabetes and their infants were less likely to have IUGR, to be small for gestational age, or to have low APGAR scores (Rakhshani et al., 2012). More women in the yoga group also had a healthy reduction in platelet count (Jayashree et al., 2013) and a greater reduction in perceived stress (Deshpande et al., 2013). Moreover, fetal measurements in the yoga group were higher for biparietal diameter, head circumference, femur length, and fetal weight, and the yoga group also had better uteroplacental and fetoplacental blood flow (Rakhshani et al., 2015).

Of all of the areas of women's health covered in this chapter, yoga for pregnancy would appear to have the most positive evidence in terms of both physiological and psychological beneficial effects for pregnant women, as well as more positive outcomes for their fetuses/neonates. However, information about adverse events was generally not included in these studies, nor was information about possible yoga-related negative effects that did not rise to the level of being named an adverse event. Close monitoring and reporting would seem to be especially important in yoga studies of high-risk pregnancy.

Polycystic ovarian syndrome

Pathophysiology, etiology, and prevalence

Polycystic ovarian syndrome (PCOS) is a female endocrine disorder characterized by polycystic ovaries, hyperandrogenism, and irregular menses. Prevalence estimates using Rotterdam criteria range from 14.6% to 19.9% across a number of countries. Frequently, problems with insulin resistance among women with PCOS lead to metabolic syndrome, hypertension, dyslipidemia, glucose intolerance, and type 2 diabetes (Sirmans & Pate, 2013).

The underlying pathophysiology of PCOS is not well understood. Association between stress and PCOS has been documented (Harrison, Lombard, Moran, & Teede, 2011). In addition, studies suggest that chronic stimulation of sympathetic activity can induce dysregulation of the hypothalamus–pituitary–ovarian axis (HPO axis) in women with PCOS (Virsaladze, Natmeladze, Topuria, Natmeladze, & Paichadze, 2006). Increased SNS activity may be linked to hyperandrogenism (Sir-Petermann et al., 2002) and hyperinsulinemia (Fagius, 2003). Furthermore, growth hormone (GH) and insulin growth factor-1 (IGF-1) play central roles in regulating sympathetic nerve activity. Disturbances in both central (somatotrophic axis) (Wu et al., 2000) and peripheral (greater density of catecholaminergic) (Greiner, Paredes, Araya, & Lara, 2005) nerve fibers of the SNS have been observed in polycystic ovaries.

Scientific/physiological rationale for use of yoga

To the extent that PCOS is characterized by increased SNS activity and dysregulation of the HPO axis, yoga treatment might be expected to yield improvements in these systems (see rationale in prior sections). However, it is not clear what specific or direct effects yoga treatment would have on PCOS symptoms or comorbidities.

Research summary

Only one study of yoga treatment for PCOS has been conducted (with three publications). In this study of adolescent girls, those in the yoga group, compared with those in the control (physical exercise) group, had greater improvement in fasting insulin, fasting blood glucose, and homeostasis model assessment of insulin resistance; decreased low-density lipoprotein, very low-density lipoprotein, triglycerides, and total cholesterol (Nidhi, Padmalatha, Nagarathna, & Ram, 2012a); lower trait anxiety (Nidhi, Padmalatha, Nagarathna, & Amritanshu, 2012a); decreased levels of anti-Müllerian hormone, luteinizing hormone, and testosterone; decreased hirsutism; and improved menstrual frequency (Nidhi, Padmalatha, Nagarathna, & Amritanshu, 2013). Thus, yoga appeared to result in the improvement of PCOS symptoms as well as markers related to the risk of comorbid conditions. More work is clearly needed in this area before drawing firm conclusions about yoga for PCOS.

Discussion and conclusions

The results reported herein indicate that yoga is a promising treatment for women's health issues, although much more research needs to be done in this area. Extant results should be interpreted with caution, given a number of caveats that apply to yoga research in general and the research reviewed in this chapter in particular. As is evident in Table 20.1 (p. 452), only one study (Newton et al., 2014; Reed et al., 2014) included details on yoga instructor training, instructor's fidelity to the intervention, participant adherence, and adverse events, although other studies included some of these categories. Without this information, it is not possible to ascertain whether yoga interventions were delivered as intended or whether participants received an adequate "dosage" of the yoga treatment. In particular, relying on home practice entirely (e.g., Rakhshaee, 2011; Sakuma et al., 2012) or in combination with in-person classes (e.g., Newton et al., 2014; Rakhshani et al., 2010), even when home practice is tracked via participant diaries, is challenging for determining actual dosage. Moreover, analyses that take dosage into account were included in only a handful of studies (Joshi et al., 2011; Newton et al., 2014; Nidhi et al., 2012). In addition to dosage, it is important to ensure adequate sample size and power, which was addressed in some, but not all, studies reviewed.

Another issue of note is the selection of an appropriate control group to compare with yoga treatment. Although some studies included a control group that received no treatment or treatment-as-usual (e.g., Newham et al., 2014; Rani et al., 2013), other studies included more active controls such as walking (Elavsky & McAuley, 2007a; Rakhshani et al., 2012), other types of exercise (Chattha et al., 2008b; Newton et al., 2014; Rakhshani et al., 2010), passive stretching (Afonso et al., 2012), education (Avis et al., 2014; Martins & Silva, 2014); massage (Field et al., 2012), support group (Field et al., 2013), and casual conversation with researchers (Chuntharapat et al., 2008). Although it is beyond the scope of this chapter to thoroughly address the issue of appropriate control or comparison groups for yoga treatment, it is worth noting that studies controlling for physical effort or attention to participants may be especially important in accounting for possible placebo effects of yoga treatment or effects related to physical activity in general.

Additional parameters of note are the type of yoga (or yoga tradition) from which the yoga treatment is derived, the selection and sequencing of the components of the treatment, the philosophical or physiological rationale underlying these choices, and the frequency and intensity of treatment. Review of the studies included in Table 20.1 (p. 452) indicates extensive variability among these parameters, although most yoga treatments included the elements of asana, breathing, relaxation and/or meditation, and most lasted 8–12 weeks. Some yoga sessions were as short as 15 or 20 minutes (e.g., Field et al., 2012; Sakuma et al., 2012), while most were 1–2 hours. Frequency of yoga sessions varied from daily (e.g., Nidhi et al., 2012) to weekly or less frequently (e.g., Chuntharapat et al., 2008; Newton et al., 2014), although daily home practice also was encouraged in a number of studies. It is, nonetheless, encouraging that studies reporting similar significant effects of yoga for women's health did so in spite of a lack of uniformity of treatment parameters.

Finally, it is important to consider the cultural context in which these yoga studies were conducted. Most of the studies took place in the United States or India, which could limit their generalizability. Also, in comparing the frequency of yoga practice in the studies from the United States and India, it is clear that more intensive treatment was provided in India across most studies. Because yoga is part of the cultural heritage of India, it may have been more acceptable and possible to recruit women into studies in which, for example, daily yoga sessions were required. Again, it is noteworthy that similar effects of yoga for women's health were found across cultures despite these differences.

Future directions for yoga research for women's health might involve the systematic exploration of the many parameters that have varied or remained uncontrolled in previous research (e.g., type, dosage). More frequent incorporation of physiological measures would provide important information about whether the positive effects of yoga treatment experienced by women have a physiological basis—which would not make them any more "real" than subjective experience, but would advance our understanding of the mechanisms whereby yoga impacts women's health. Finally, most studies of yoga for women's health (and for other conditions and symptoms) have tested a relatively brief intervention for yoga-naive participants, but it is possible that the primary effects of yoga would be revealed after practicing for a longer period of time. Though such studies are challenging to conduct for practical reasons, the extant short-term studies may be underestimating the true impact of yoga.

Table 20.1 Randomized controlled trials of yoga for menopause, menstrual issues, pregnancy, and PC

Menopause						
Authors	**Year**	**Study design**	**Subject types**	**Initial sample size**	**Yoga intervention details**	**Fidelity to intervention**
Avis et al.	2014	RCT with 3 groups: Yoga, Health & Wellness Education (HW); Waitlist (WL)	Late PeriMP 45–58 years HF ≥ 4 per day, ≥ 4 weeks	Yoga (*n* = 18) HW (*n* = 19) WL (*n* = 17)	10 weekly 90-min Integral Yoga classes (breathing, asana, relaxation) 15 min DVD 3 × /week at home	–
Newton et al.	2014	RCT, 3 × 2 factorial with 3 groups: Yoga, Exercise, Usual Activity Each group also randomly assigned to either omega-3s or placebo	PeriMP or PostMP 40–62 years HF/NS ≥ 14 per week for 3 weeks; decrease on week 3 was not more than 50 of weeks 1 and 2 average	Yoga (*n* = 107) Exercise (*n* = 106) Usual activity (*n* = 142)	12 weekly 90-min yoga classes (cooling breathing exercises; 11–13 asana; yoga nidra) Daily at home practice 20 mins. When not in class, alternating yoga nidra and poses each day	Instructors taught to strictly adhere to protocol and were observed each class by a research staff member who completed a yoga protoco adherence log. Investigators had weekly contact with instructors via email to discuss AEs, adherence, questions.
Reed et al.	2014	See Newton et al., 2014	See Newton et al., 2014	See Newton et al., 2014	See Newton et al., 2014	See Newton et al., 2014
Afonso et al.	2012	RCT with 3 groups: Yoga, Passive Stretching, Control	PostMP 50–65 years Insomnia	Yoga (*n* = 15) Passive stretching (*n* = 14) Control (*n* = 15)	4 months' classes, 2 sessions per week, 60 minutes each Yoga: asana, breathing, relaxation; Passive stretching:	–

					manipulations by physical therapist	
Joshi et al.	2011	RCT with 2 groups: Yoga, Control	Irregular cycles or postMP 40–55 years	Yoga (*n* = 100) Control (*n* = 100)	Yoga camp daily for 3 months 6–7:00 am Yoga: asana, breathing, meditation	–
Chattha et al.	2008a	RCT with 2 groups: Yoga, Exercise Control	MPT & PostMP 40–55 years	Yoga (*n* = 59) Exercise Control (*n* = 61)	5 days/week, 1 hour, for 8 weeks Yoga: integrated approach to yoga therapy (IAYT): asana, breathing, meditation, lecture. Exercise: easy body movements, lecture	–
Chattha et al.	2008b	See Chattha et al., 2008a	See Chattha et al., 2008a	See Chattha et al., 2008a	See Chattha et al., 2008a	See Chattha et al., 2008a
Elavsky & McAuley	2007c	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a
Elavsky & McAuley	2007b	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a	See Elavsky & McAuley, 2007a
Elavsky & McAuley	2007a	RCT with 3 groups: Yoga, Walking, Control	PreMP, periMP, postMP, sedentary or low active, VMS in last month 42–58 years	Yoga (*n* = 62) Walking (*n* = 63) Control (*n* = 39)	Yoga: 4 months, 2 times per week for 90 mins. Iyengar yoga, plus home practice. Walking: 4 months, 3 times per	–

					week for 60 mins. Supervised program with individual exercise prescriptions	
Menstrual issues						
Kanojia et al.	2013	RCT with two groups: Yoga, Control	"Apparently healthy" women 18–20 years	Yoga (*n* = 50) Control (*n* = 50)	Yoga 35–40 min/day, 6 times per week, for 3 menstrual cycles (yogic prayer, micro exercises, macro exercises, breathing, asana, meditation). No asana during menstruation	–
Sharma et al.	2013	RCT with three groups: Anulomaviloma (AV), Asana, Control	Women with PMS, regular cycle. 18–40 years	AV (*n* = 20) Asana (*n* = 20) Control (*n* = 20)	AV (alternate nostril breathing) or asana daily for 7 days prior to expected menstruation for 3 cycles	–
Rani et al.	2013	RCT with two groups: Yoga, Control	Women with menstrual disorders: dysmennorrhea, pathological amenorrhea, oligomenorrhea, polymenorrhea, menorrhagia, metrorrhagia, hypomenorrhea	Yoga (*n* = 75) Control (*n* = 75)	Yoga nidra 35–40 mins per day 5 times per week for 6 months. Both groups had conventional medication	–
Monika et al.	2012	See Rani et al., 2013	See Rani et al., 2013	See Rani et al., 2013	See Rani et al., 2013	See Rani et al., 2013

Sakuma et al.	2012	RCT with two groups: Yoga, Control	Healthy female nursery school and kindergarten teachers, 20–64 years	Yoga (n = 83) Control (n = 40)	DVD of home-based 15 min, 2-week yoga program; 4 additional weeks of practice encouraged (asana, pranayama)	–
Rakhshaee	2011	RCT cluster randomization with two groups: Yoga, Control	Women with primary dysmenorrhea 18–22 years	Yoga (n = 50) Control (n = 42)	Yoga booklet with 20 min program and 3 poses: cobra, cat & fish poses to be performed during luteal phase	–
Pregnancy						
Rakhshani et al.	2015	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012
Newham et al.	2014	RCT with 2 groups: Yoga, Treatment as Usual	20–24 weeks pregnant Normal pregnancy, primiparous women	Yoga (n = 31) Control (n = 28)	8 weekly sessions of mild hatha yoga (breathing, asana, relaxation)	–
Martins & Silva	2014	RCT with 2 groups: Yoga, Postural-orientation pamphlet	12–32 weeks pregnant Pregnancy-related low-back pain (PLBP or pregnancy-related pelvic girdle pain (PGP)	Yoga (n = 30) Control (n = 30)	10 weekly yoga sessions. Hatha yoga (asana, breathing, meditation, relaxation)	–

Satyapriya et al.	2013	See Satyapriya et al., 2009	See Satyapriya et al., 2009	See Satyapriya et al., 2009	See Satyapriya et al., 2009	See Satyapriya et al., 2009
Deshpande et al.	2013	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012
Jayashree et al.	2013	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012	See Rakhshani et al., 2012
Field et al.	2013	RCT with 2 groups: Yoga, Social support control	22 weeks pregnant, prenatal depression, normal pregnancy	Yoga (*n* = 46) social support (*n* = 46)	12 weeks, once per week, 20 mins. yoga (asana only) or leaderless discussion group	–
Field et al.	2012	RCT with 3 groups: Yoga, Massage, Standard Care	20 weeks pregnant, prenatal depression, normal pregnancy	Total *n* = 84 (no information on *n* per group)	12 weeks, 2 times per week, 20 mins. yoga (asana only) or massage, 20–32 weeks of pregnancy	–
Rakhshani et al.	2012	RCT with 2 groups: Yoga, Walking	12 weeks pregnant, high-risk (history of poor outcome; twins; extreme	Yoga (*n* = 46) Control (*n* = 47)	1-hr yoga session 3 times per week from weeks 13 to 28 of pregnancy	–

			age; obesity; family history of poor outcome)		(breathing, asana, meditation, relaxation); or 1 hr of walking per day 3 times per week	
Rakhshani et al.	2010	RCT with 2 groups: Yoga, Prenatal exercise routine	18–20 weeks pregnant, normal pregnancy	Yoga (*n* = 56) Control (*n* = 53)	1-hr session, 3 days per week for 1 month; 1 hour per day at home thereafter; 1 hour refresher classes during antenatal visits. Yoga group: Integrated Approach to Yoga (IAYT) (breathing, asana, meditation, relaxation, lecture); control group: prenatal exercise routine	–
Satyapriya et al.	2009	RCT with 2 groups: Yoga, Prenatal exercise routine	18–20 weeks pregnant Normal pregnancy	Yoga (*n* = 59) Control (*n* = 63)	Both groups: 2-hr sessions, 3 days per week for 1 month; 1 hour per day at home thereafter; 1 hour refresher classes every 4th week up to 28 weeks pregnant; every 2 weeks up to 36 weeks pregnant. Yoga group: Integrated Approach to Yoga (breathing, asana, meditation, relaxation,	–

					lecture); control group: prenatal exercise routine	
Chuntharapat et al.	2008	RCT with 2 groups: Yoga, Control	26–28 weeks pregnant, primigravidas, normal pregnancy	Yoga (*n* = 37) Control (*n* = 37)	60-mins, 6 times (26–28, 30, 32, 34 36, 37 weeks of pregnancy); home practice 3 times per week for 10–12 weeks Asana, chanting, breathing, relaxation, meditation; control group: casual conversation with researchers for 20–30 mins during hospital visits	–
PCOS						
Nidhi et al.	2013	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a
Nidhi et al.	2012b	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a	See Nidhi et al., 2012a
Nidhi et al.	2012a	RCT with two groups: Yoga, Control	Girls with PCOS (2/3 features using Rotterdam criterion) in residential school. 15–18 years	Yoga (*n* = 42) Control (*n* = 43)	1 hour per day for 12 weeks (90 sessions). Yoga: asana, breathing, meditation, relaxation, lecture). Control: physical exercises, rest, lecture. All girls received at least one 1-hr	–

		session of individualized counseling

Note. Within each section, articles are arranged by publication year, from most recent to oldest.

[a] Unless otherwise noted, results are shown for changes in the yoga group pre- and posttreatment, compared with changes in control group.

*$p \le .05$; **$p \le .01$; ***$p < .001$; AEs: adverse events; AMH: anti-Müllerian hormone; FSH: follicle-stimulating hormone; HFs: hot flashes; LH: luteinizing hormone; MENQOL: menopause-related quality of life; mFG: modified Ferriman and Gallway score; MP: menopausal; MPT: menopausal transition; NS: night sweats; PCOS: polycystic ovarian syndrome; PE: preeclampsia; PIH: pregnancy-induced hypertension; PreMP: premenopausal; PeriMP: perimenopausal; PostMP: postmenopausal; RCT: randomized controlled trial; STRAW: Stages of Reproductive Aging Workshop; SVYASA: Swami Vivekananda Yoga Anusandhana Samsthana; TSH: thyroid-stimulating hormone; VMS: vasomotor symptoms.

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Obstetrics and Gynecology: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Carrie Demers says, “Perimenopause is a period of transition and instability, and therefore *vata* imbalance,” from an ayurvedic point of view. “Typical menopausal symptoms, like dryness (skin and vaginal), insomnia, irritability, and hot flashes result from the wind (vata) blowing on the fire (*pitta*). So working to pacify both these wayward *doshas* is helpful.” Some women develop *kapha* disturbances as well such as edema, weight gain, increased mucus production, she says, but in her experience these are less common.

While all of the usual lifestyle advice for calming vata is helpful, Demers says, she also often recommends *agni sara* . This practice is said to stoke the *agni* (digestive fire). She cautions, however, that “the practice might initially trigger a hot flash, but then keep the fire more steady over time,” especially with consistent practice. “Agni sara is classically done standing,” she says; “however, this is often challenging to tight or weak muscles in the arms, shoulders, and necks. So I often teach it in a supine position with knees bent, feet on the floor.”

After the student has gotten comfortable with supine slow deep breathing, Demers says, she invites the student to “exaggerate the exhale, squeezing the belly back toward the floor. Once that is established, I add *mula bandha* [root lock] on the exhale, release on the inhale. Then I invite more refinement in articulation: contracting the lower abdomen, then the middle, then the upper in a wave-like manner.” Eventually, she will expand the practice to include *uddiyana bandha* (abdominal lock) with *jalandhara bandha* (throat lock) and eventually *nauli* (abdominal churning). She also often recommends *nadi shodhana* (alternate-nostril breathing). “It is especially calming and balancing, so very helpful in this phase of change and instability.”

Ulrica Norberg says that a prenatal yoga practice should help “boost vitality, reduce stress, and help relieve common pregnancy ailments such as fluid retention and backache.” A common theme in the practices she prescribes is to restore energy and enhance circulation using soft movements coordinated with the breath. She also tends to focus on pranayama, meditation, and relaxation techniques.

Norberg believes that, because the effects of the hormone relaxin, it’s vital not to go too deeply into the poses or try to advance in one’s practice. “Pregnant women can very easily injure themselves because their joints are so loose. So if we have a quite strong and sweaty practice with many advanced poses and fast flow, it will bring much more pressure onto our joints and ligaments.”

For the same reason, Eliana Moreira recommends that teachers exhibit caution with any hands-on adjustments of pregnant students. She has seen prenatal students who developed painful separation of the pubic bones during *baddha konasana* (cobbler’s pose) when a teacher unwisely pushed on their knees to bring them more deeply into the pose.

Norberg says that pregnant women “can still have a regular yoga practice, but focusing more on alignment, soft flowing movements, restorative yoga and pranayama while avoiding jumping, lying on the belly, deep rotating poses, and heavy pressure on the head like in headstand.” *Viparita karani* (legs-up-the-wall pose), which Norberg finds, “can also relieve nausea, can be a good alternative.”

Moreira has found that it can be safe to continue headstand during pregnancy with experienced students who have had a regular inversion practice in place for years. She has them do the pose with their backs at a wall, and places a chair a couple of feet in front of them, on which they place their feet to facilitate moving more easily in and out of the pose. Once they are in the pose, she has students keep their heels on the wall and work to carry more weight in their arms, taking the pressure off the head. “These women love their headstands. It keeps them fresh and energized. Usually at some point in the third trimester, either because the baby’s gotten too heavy, they’re more tired or, most importantly, their breathing becomes more difficult, they realize it’s time to give up the practice until after they deliver.”

Figure 20.1

Because this twist is done seated in a chair, it is often convenient for pregnant women to do it one or more times during the course of their day.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

If hypertension develops during pregnancy, Norberg says, “Students should avoid both standing poses and inverted poses. They should get as much rest as possible, preferably lying on their left side to rest the heart. They can do sitting poses. Simple breathing calms the nervous system, but any form of inhalation retention should be avoided.” In preeclampsia being treated with bed rest, she finds that “quiet breathing and meditation techniques” are fine.

Moreira often recommends pranayama—especially *bhramari* (buzzing bee) breath. “Several of my prenatal students have told me it was bhramari more than anything that got them through labor and delivery. It’s calming to the nervous system and mind. And it gets them comfortable making noise, which isn’t always easy for some women—especially during labor—so it’s good training.” Also very relaxing for many of her students is the guided relaxation practice *yoga nidra.* She either guides the practice herself or suggests the students buy one of the many recorded versions available commercially.

While Moreira avoids most twists in pregnancy, she has had good luck with *bharadvajasana* , especially when it’s done in a chair (see Fig. 20.1). “I tell students to not engage the belly at all during the twist, but instead just allow the baby to go where it naturally goes. That turns out to almost always be away from the direction of the twist. So if we’re turning to the right, the baby naturally falls to the left. Chair bharadvajasana is extremely safe, and I’ve found it’s one of the most practical for them to do at home.”

Figure 20.2
A rolled blanket under the neck, in reclining cobbler’s pose, can help maintain a healthy cervical curve.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

”My go-to pose in all three trimesters,” says Moreira, “is supported *supta baddha konasana* [reclining cobbler’s pose], with the chest supported on a cylindrical bolster, and the head propped. Since many pregnant women have back pain, I’ll sometimes place a blanket on the floor in front of the bolster, which often seems to help. If the student has trouble maintaining a natural cervical curve, I'll often roll a blanket or towel and place it under the neck (see Fig. 20.2). I'll also place pillows or other props underneath each leg, so that there is absolutely no tension in the groins. In this pose and in the practice in general, I suggest they do a slow, deep, complete yogic breath throughout, making a gentle *ujjayi* sound, as long as they don't find it too heating. My mothers-to-be just love supta baddha konasana. Of all the practices I teach them for their home practice, this is the one they report doing regularly."

Resources

Book: *Balance Your Hormones, Balance Your Life* by Claudia Welch

Book: *Every Woman's Yoga* by Jaime Stover Schmitt

Book: *Iyengar Yoga for Motherhood* by Geeta Iyengar

Audio: *Relax into Greatness* (Yoga Nidra) by Rod Stryker

CHAPTER TWENTY-ONE

YOGA FOR PREVENTION AND WELLNESS

A ROSS • A MICHALSEN

Pathophysiology, etiology, and prevalence

Throughout history, individuals worldwide have died from diseases that were mostly communicable in nature. Top killers in 1900 included infectious diseases such as pneumonia, tuberculosis, and gastrointestinal infections (Jones, Podolsky, & Greene, 2012). Today, with the advent of antibiotics and improved infection-control measures, deaths from infectious disease in developed countries are rare. At present, five of the top seven causes of mortality are noncommunicable in nature and lifestyle-related including heart disease, cancer, chronic lung disease, stroke, and type 2 diabetes (Jones et al., 2012). These diseases are becoming increasingly more common, with nearly one in two American adults having at least one chronic health condition (Bauer, Briss, Goodman, & Bowman, 2014). Worldwide, chronic, non-communicable diseases were responsible for 68% of deaths in 2012, up nearly 10% from the previous decade (World Health Organization, 2014). Chronic diseases such as diabetes can lead to complications such as heart attacks, blindness, and amputation that are debilitating to the individual and costly to the economy, with one in every five healthcare dollars in the United States spent on diabetes care (American Diabetes Association, 2008).

Chronic lifestyle-related health conditions are attributed primarily to a short list of risk factors, including poor nutrition and physical inactivity (both strongly related to obesity), tobacco use, excessive alcohol consumption, hypertension, and high cholesterol (Bauer et al., 2014). Obesity is a worldwide epidemic that underlies many chronic health conditions, including cardiovascular disease, type 2 diabetes (T2DM), and musculoskeletal disorders. Obesity-related health costs in the United States alone run to nearly $150 billion per year (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

In the field of public health, there are three ways to manage disease: primary, secondary, and tertiary prevention. Primary prevention consists of measures taken to prevent disease or infirmity, while secondary prevention is the early diagnosis and treatment of conditions to prevent disease progression. Tertiary prevention focuses on treating established diseases to restore function and reduce complications. Treating chronic diseases using tertiary prevention is not only costly but ineffective; for example, only one-third to one-half of individuals with high cholesterol and hypertension are able to maintain adequate control (Hyre, Muntner, Menke, Raggi, & He, 2007). The key to changing the trajectory of the world's health and reducing skyrocketing health care costs lies in primary prevention through changing unhealthy lifestyles. Reducing blood pressure, body weight, blood sugar, and cholesterol by only 1% could save $83 to $103 per person annually in medical costs (Henke et al., 2010). Yoga shows promise as a lifestyle intervention for improving many of the risk factors associated with chronic disease. As such, yoga is preventive medicine.

Scientific rationale for yoga as preventive medicine

In order to understand how yoga is preventive medicine, one must understand the physiology underlying the development of lifestyle-related diseases. According to the theory of allostatic load, lifestyle-related diseases result from dysfunction of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic–adrenal–medullary (SAM) system in response to chronic exposure to stress (McEwen & Gianaros, 2010). When an individual experiences a real or perceived threat, whether it is a major life event, a trauma, work-related, family-related, or a societal stressor, a network within the brain that includes the amygdala, the hippocampus, and the prefrontal cortex becomes activated, leading to the secretion of glucocorticoids, catecholamines, and inflammatory cytokines (McEwen & Gianaros, 2010). Cortisol, a glucocorticoid, causes glucose and fatty acids to pour into the bloodstream, while the catecholamines norepinephrine and epinephrine lead to increases in heart rate, blood pressure, and respiratory rate; this allows rapid delivery of oxygen and nutrients to defend against the threat. Hormones causing fluid retention and increased blood pressure, including antidiuretic hormone, aldosterone, renin, and angiotensin, are released, and those hormones needed for long-term growth and maintenance such as cell repair, bone growth, and sexual reproduction are turned off. Platelets become more reactive, allowing the blood to clot more quickly and prevent blood loss in the event of a life-threatening injury, while inflammatory cytokines are released as an immune response to limit the growth of pathogens and minimize tissue damage in the event of an infection (McEwen & Gianaros, 2010).

Although this response to stress is adaptive in the short-term, repeated or prolonged stimulation of the HPA and SAM systems results in dysregulation of these systems, a condition known as *allostatic load* (McEwen, 1998). Allostatic load is the wear and tear that occurs within the HPA-axis and SAM system with repeated and prolonged activation, which ultimately contributes to the development of diseases of slow accumulation such as obesity, cardiovascular disease, T2DM, and cancer, as well as depression and dementia (McEwen, 1998). These diseases develop via a number of pathways. Chronic stress leads to an increased reactivity of the amygdala, inflammation, and metabolic abnormalities that contribute to the progression of atherosclerosis and cardiovascular disease, as well as a decreased cellular sensitivity to insulin that leads to the development of T2DM (McEwen & Gianaros, 2010). High levels of cortisol and inflammation associated with chronic stress lead to neurodegeneration and ultimately cognitive decline and dementia (McEwen & Gianaros, 2010). In short, chronic stress leads to accelerated cellular aging (McEwen & Gianaros, 2010).

Genes, past experience, and lifestyle choices greatly influence the development of allostatic load. Individuals who engage in healthy activities, including proper nutrition, physical activity, and sleep and who avoid tobacco and excessive alcohol consumption are buffered from the damaging effects of chronic stress and from certain genetic and environmental predispositions for disease (McEwen & Gianaros, 2010). Unfortunately, unmanaged stress frequently alters health behaviors, because individuals who are stressed are less likely to exercise and more likely to smoke; ingest excessive amounts of alcohol; and consume foods high in sugar, fat, and salt, contributing to addictions and obesity (Sinha & Jastreboff, 2013).

Yoga is beneficial in reducing allostatic load because it appears to turn off the HPA–SAM response to stress, lowering levels of cortisol, norepinephrine, and epinephrine, reducing levels of inflammatory cytokines, and enhancing immune system function (Ross & Thomas, 2010). Yoga improves a number of downstream outcomes associated with the HPA–SAM activation such as blood glucose and insulin levels, heart rate, blood pressure, and blood cholesterol (Innes, Bourguignon, & Taylor, 2005). Yoga is thought to elicit these effects via downregulation of the HPA-axis by increasing brain levels of gamma-aminobutyric acid (GABA) (Streeter et al., 2010), a neurotransmitter that has anti-anxiety effects and inhibits the release of adrenocorticotropic hormone, the hormone released by the pituitary gland that triggers the HPA-axis response to stress. Second, yoga is believed to decrease SAM stimulation by activating the parasympathetic nervous system, possibly by vagal stimulation (Innes et al., 2005). Activation of the parasympathetic nervous system induces a relaxation response that reduces heart rate and stimulates digestion, sleep, and a general sense of well-being. Yoga is assumed to increase vagal stimulation, but it can only be measured indirectly by examining heart rate variability. Yoga appears to increase the type of heart rate variability that is associated with vagal stimulation (Khattab, Khattab, Ortak, Richardt, & Bonnemeier, 2007).

In addition to physiological changes associated with yoga practice that may lead to improved health, the practice of yoga may have a positive impact on health via behavioral pathways as well. Yoga practice is associated with increased body awareness, interoception, mindfulness, and well-being (Gard, Noggle, Park, Vago, & Wilson, 2014; Ross, Friedmann, Bevans, & Thomas, 2012). Yoga practitioners report that their practice helps to improve their mood and attitude, making them more kind and patient, leading to improvements in their interpersonal relationships (Ross, Bevans, Friedmann, Williams, & Thomas, 2014). Individuals who feel better, have adequate social support, and are more self-aware may practice more health-promoting behaviors such as eating a healthy diet, exercising, and getting adequate sleep. Indeed, yoga appears to improve the mood and motivation of previously sedentary individuals, helping improve their adherence to physical activity (Bryan, Pinto Zipp, & Parasher, 2012).

There are a number of proposed mechanisms through which yoga may prevent the development or progression of disease, including both physiological and behavioral pathways. The following sections will explore the research literature supporting the use of yoga in reducing stress and improving risk factors for disease.

Research supporting yoga as preventive medicine

In modern societies, an increasing proportion of the population worldwide suffers from perceived stress and/or distress. High levels of stress are associated with increased morbidity and mortality (McEwen, 1998). Through its inherent components of exercise, relaxation, breath work, and stretching, yoga encompasses several modalities that are capable of reducing perceived stress. Interventional studies of the impact of yoga on stress have mostly demonstrated good effectiveness. Limitations of these studies are the result of small sample sizes and lack of randomization or inadequate control interventions with regard to nonspecific factors such as practice duration, attention, setting, and group support. In most studies, perceived stress was measured using scores from validated questionnaires, most commonly the Cohen Perceived Stress Scale (CPSS or PSS). Yoga interventions have been studied in multiple distinct populations. In an uncontrolled study, Simard and Henry (2009) documented improved perceived stress and general health scores in 14 medical students after 16 weeks of yoga. In a nonrandomized study, Kjellgren and colleagues (2007) investigated 48 subjects receiving yoga training and 55 subjects receiving relaxation training within a 6-week pilot study. Significant decreases in stress scores were found for the yoga group only (Kjellgren, Bood, Axelsson, Norlander, & Saatcioglu, 2007). Michalsen et al. (2005) studied women who were emotionally distressed within a controlled nonrandomized 3-month pilot study. Compared to the controls (n = 8) the 16 women receiving the yoga training showed pronounced decreases in their PSS scores and improved general health and quality-of-life scores (Michalsen et al., 2005). In an RCT (randomized controlled trial), pregnant women had significant reduction in PSS scores as well as increased heart rate variability after a 16-week yoga intervention (*n* = 45) compared to a deep-relaxation control group (*n* = 45) (Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009). The effectiveness of yoga was also evaluated among a population of firefighters (*n* = 72) in an uncontrolled study; after four yoga classes over a 6-week period the firefighter PSS scores decreased significantly and functional movements improved (Cowen, 2010). Hartfiel and coworkers (2011) evaluated the effectiveness of yoga for the improvement of well-being and resilience to stress in the workplace for employees at a British university. Forty-eight employees were randomized to a 6-week yoga intervention with one weekly 60-minute class or to a waitlist control. The yoga intervention resulted in improved self-reported mood and well-being and increased life satisfaction and self-confidence (Hartfiel et al., 2011). In a further study by the same group, 74 employees from a British government authority with perceived distress and back pain were randomized to an 8-week yoga intervention (a 50-minute session weekly plus a 20-minute DVD) or a waitlist control. In comparison to the control group, the yoga group reported significant reductions in perceived stress and back-pain intensity and improvements in mood and well-being (Hartfiel et al., 2012). In a study on 63 female community residents in Taiwan, 30 subjects were randomized to an 8-week hatha yoga course with one weekly 90-minute session or a control group. After one 8-week session, yoga led to reduced PSS scores and improved heart rate variability (Huang, Chien, & Chung, 2013).

Some studies have examined the comparative effectiveness of different intensities of yoga training on outcomes. In a three-armed randomized study, 72 female subjects with high levels of self-reported stress were randomized to one of two Iyengar yoga programs with either one or two 90-minute weekly classes over 12 weeks or to a wait-list control group. Both yoga groups were comparably superior to the control group after the 12-week intervention and showed comparable favorable effects on PSS scores, mood, psychological well-being, physical symptoms, and quality of life (Michalsen et al., 2012). Of note, despite being offered all of the yoga programs cost free, the group that was randomized to twice weekly yoga practice had difficulties complying with attendance to the program due to time constraints. Thus, the feasibility of higher intensities of yoga practice in public classes may be limited in real-world settings.

Interestingly, results on perceived stress in studies in which a yoga intervention was compared to other forms of physical activity or/and relaxation have been mixed. In two smaller randomized studies, African dance or cognitive behavioral therapy was found to be equivalent to yoga in reducing PSS scores (Granath, Ingvarsson, von Thiele, & Lundberg, 2006; West, Otte, Geher, Johnson, & Mohr, 2004). In a larger RCT from India on 120 perimenopausal women with climacteric symptoms and distress, an 8-week yoga intervention was superior to physical exercise in reducing perceived stress (Chattha, Raghuram, Venkatram, & Hongasandra, 2008). In a large multi-center RCT involving 171 individuals with metabolic disorder, researchers found that a year-long program of stretching was significantly better than restorative yoga in decreasing levels of salivary cortisol, stress severity, and perceived stress (Corey et al., 2014). This may also underline the potential efficacy of stretching interventions per se, because stretching has recently been demonstrated to be as effective as yoga in a trial on low-back pain comparing yoga and stretching interventions (Sherman et al., 2011).

In conclusion, the current available evidence from clinical studies evaluating the effects of yoga on stress and well-being is rather preliminary. The studied populations are relatively small and heterogeneous, and the studies have a number of relevant methodological limitations. However, the clear majority of trials comparing yoga to wait-list or passive controls found significant beneficial effects of yoga practice on perceived stress. Studies that compare yoga to more-active control interventions show more inconsistent results, pointing to the need of future studies to include control groups that receive different forms of active exercise and receive the same amount of social support. Furthermore, the various forms of yoga styles and techniques may differ regarding their effect on stress and well-being (Li & Goldsmith, 2012). Therefore, comparative effectiveness studies evaluating the different styles of yoga would be helpful in determining which forms of yoga are more feasibly practiced in real-world conditions and which are the most effective at reducing perceived stress and enhancing general well-being.

Lessons learned from long-term yoga practitioners

Arguably, the best method of examining the impact of yoga practice on disease prevention would be via prospective, longitudinal studies in which individuals are randomized to groups that practice yoga or to control groups with no yoga practice and then are followed for many decades to see if there were differences in symptom development and disease incidence in the two populations. However, such research is prohibitively expensive and fraught with potential confounding threats. Although retrospective studies using survey methodology are more feasible and have been utilized frequently, there are a few population-based longitudinal studies that have included questions about yoga practice. The Nurses' Health Study, a population-based, prospective, longitudinal study following 99,316 US women for eight years found that participation in activities requiring muscle strength, including weight training and yoga, was associated with a lower risk of developing type 2 diabetes (Grontved et al., 2014). In a population-based survey of 19,209 Australian women, those who practiced yoga or meditation often reported better general health and vitality than those who practiced sometimes, rarely, or never ($p < .005$) (Sibbritt, Adams, & van der Riet, 2011). While no studies to date specifically have followed yoga practitioners longitudinally, there have been a number of cross-sectional survey studies that have examined long-term practitioners of yoga, and these studies have contributed to the evidence about the individuals who practice yoga and its effects on their health. Across a number of studies, yoga practitioners are predominantly female, white, and college educated, and many of these practitioners report being drawn to yoga to improve their health or to treat specific health conditions (Birdee et al., 2008; Ross, Friedmann, Bevans, & Thomas, 2013; Sibbritt et al., 2011).

In a national survey of 1,045 Iyengar yoga practitioners that examined the relationship between yoga practice and a number of health outcomes, Ross et al. (2013) found that yoga practitioners had favorable outcomes compared to national norms in disease risk factors including the prevalence of obesity (4.9% vs. 35.7%) and smoking (2% vs. 21.8%), as well as the consumption of fruits and vegetables (median of 6.1 vs. 5.3 servings per day). Despite a 24.8% incidence of depression that was much higher than the average lifetime incidence in the United States of 16.2%, nearly all subjects were either moderately mentally healthy (55.2%) or flourishing (43.8%), with less than 1% considered languishing. The more frequently individuals practiced yoga, the more favorable were their levels of obesity, sleep disturbance, fatigue, fruit and vegetable consumption, mindfulness, and happiness ($p < .01$, all)(Ross et al., 2012). Similarly, Brisbon & Lowery (2011) found that advanced yoga practitioners had higher levels of mindfulness ($p < .05$) and lower levels of stress ($p < .05$) than beginning practitioners, and Vera et al. (2009) found that long-term yoga practitioners had lower levels of sleep disturbance when compared to control subjects with no yoga experience ($p = .03$). In a cross-sectional survey of 211 female yoga practitioners over age 40, Moliver and colleagues (2013) found a dose effect of yoga in that the more hours one practiced yoga, the higher their levels of subjective well-being ($p < .01$) and vitality ($p = .01$).

Several cross-sectional comparison studies compared long-term yoga practitioners to short-term and nonpractitioners and found a number of physiological differences. In a study comparing cardiac function in 50 Indian individuals over age 40 who had been practicing yoga for 5 years or more to 50 nonpractitioners, the yoga practitioners had significantly lower heart rates ($p < .001$), systolic and diastolic blood pressures ($p < .01$ and $.001$, respectively), and better baroreceptor sensitivity ($p < .001$) than the controls (Bharshankar, Bharshankar, Deshpande, Kaore, & Gosavi, 2003); the researchers concluded that, while age was correlated with worsened blood pressure readings in both groups, this correlation was weaker in the yoga practitioners, indicating that yoga practice may offer some protection against age-related decline in cardiovascular function. Another cross-sectional study compared 15 Indian males under age 35 who had practiced yoga for at least 1 year to their body mass index (BMI) and age-matched nonpractitioners with similar levels of physical activity (Chaya et al., 2008). Chaya et al. (2008) found better insulin sensitivity in the yoga practitioners, and yoga practice appeared to weaken the negative relationship between waist circumference and body weight associated with insulin sensitivity. In a repeated measures study examining 25 novice female yoga practitioners to 25 expert practitioners, Kiecolt-Glaser et al. (2010) found that, even though the two groups did not differ in age, fitness level, and abdominal adiposity, serum levels of the inflammatory cytokine interleukin-6 were 41% higher and their odds of having a detectable C-reactive protein, a biomarker of inflammation, were nearly five times higher for the novices than for the expert practitioners. In addition, leptin, which plays a role in increasing inflammation, was 36% higher, and levels of an anti-inflammatory adipocytokine, adiponectin, were 28% lower in the novice group than in the expert group (Kiecolt-Glaser et al., 2012).

Yoga and disease risk factors

While a substantial number of studies have examined the impact of yoga interventions on specific disease conditions, including cardiovascular disease, type 2 diabetes, cancer, and mental illness, few studies specifically have focused on yoga as a means of addressing the behavioral risk factors that contribute to the development of these conditions, including obesity, smoking, diet, physical activity, and excessive alcohol consumption. Perhaps the best evidence that yoga can impact an important disease risk factor involves studies examining yoga and body weight. Multiple studies have shown that yoga interventions can decrease levels of body weight, BMI, and waist circumference in a number of different populations (Rioux & Ritenbaugh, 2013), and studies of long-term yoga practitioners have found that frequency of yoga practice is associated with lower levels of obesity (Ross et al., 2012). In the population-based Vitamin and Lifestyle (VITAL) longitudinal study of 15,550 adults aged 53–57, those individuals who had practiced yoga for at least 4 years were two to four times less likely to gain weight as they aged than individuals who did not practice yoga (Kristal, Littman, Benitez, & White, 2005).

The evidence regarding the impact of yoga practice on diet and fitness is less robust. Ross et al. (2013) found that yoga practitioners had higher consumption of fruits and vegetables and had rates of vegetarianism that were four times higher than in the general US population. In a cross-sectional comparison study of 61 yoga practitioners and 135 college students, 39% of yoga practitioners reported that they often or always consumed the recommended servings of necessary food groups compared to 27% of college students ($p = .04$) (Monk-Turner & Turner, 2010). The question of whether yoga provides adequate levels of physical activity to meet guidelines for fitness has not been answered definitively, although there is some evidence that asana practice, in particular the more vigorous practices, such as sun salutations, may be of adequate intensity to improve cardiovascular fitness (Satin, Linden, & Millman, 2014). Although yoga may not improve fitness outcomes to the same magnitude as aerobic exercise, a review of the literature examining research studies comparing yoga to exercise found yoga to be as effective or more effective than exercise at improving nearly every non-fitness health outcome, including cardiovascular outcomes and blood glucose (Ross & Thomas, 2010). These findings are important, because exercise is considered an important form of preventive medicine for conditions such as cardiovascular disease and T2DM.

Considerably less research exists regarding other disease risk factors, particularly the impact that yoga might have in helping individuals to stop smoking and to reduce excessive alcohol intake, although cross-sectional studies have found yoga practitioners to have a very low prevalence rates of smoking (Ross et al., 2013; Satin et al., 2014). In a cross-sectional survey of 1,775 patients at an outpatient tobacco treatment clinic, yoga was perceived to be one of the most effective complementary and alternative treatments to assist in tobacco cessation (Sood, Ebbert, Sood, & Stevens, 2006). In an intervention study involving 76 smokers who were randomly assigned to either treadmill walking, hatha yoga, or a control group, individuals in the two activity groups experienced decreased cravings to smoke, decreased negative affect, and increased positive affect compared to controls (Elibero, Janse Van Rensburg, & Drobes, 2011).

Summary and conclusions

In summary, there is increasing evidence from human experimental, epidemiological, and clinical studies demonstrating that yoga seems to be effective in reducing distress, enhancing general well-being, and promoting a healthy lifestyle. Previous research has demonstrated that the physical activity, relaxation, stretching, and breathing control associated with yoga practice are associated with beneficial effects on the HPA-axis and the SAM system. Because yoga provides a complex combination of these modalities, the beneficial effects of these practices on the regulatory systems of the body may be synergistic in nature, with the different yoga modalities contributing unique health benefits. Further research is needed to differentiate and identify the specific health effects of specific yogic practices. Accordingly, beneficial effects on risk factors and mediators of cardiovascular disease and metabolic and inflammatory disease are increasingly documented. On the other hand, to date, the available data from clinical studies are rather preliminary.

The studies described suggest that yoga can be recommended as a primary approach to treating distress in healthy populations and as an adjunctive or supportive treatment to reduce stress and to enhance well-being in stress-associated diseases. However, for definitive conclusions, further data from well-designed trials are imperative. Furthermore, comparative-effectiveness trials should assess the value of yoga compared to other forms of physical activity and other exercise therapies that promote mindfulness such as tai chi, qigong, and others. Regarding the need for more evidence from clinical trials, the heterogeneity of the different styles and techniques also proves problematic. Restricting the focus to selected yoga styles or creating some standardization within clinical intervention protocols is important in bringing yoga forward into evidence-based medicine and clinical practice. At a minimum, intervention studies should publish clear and detailed descriptions of the yoga practices utilized in research studies.

Yoga interventions appear to help with weight loss and reductions in abdominal adiposity in epidemiological data, potentially making multimodal yoga a useful intervention to prevent obesity and obesity-related health conditions such as cardiovascular disease, type 2 diabetes, and certain cancers. Future research is needed to determine the specific yoga practices that aid in weight loss and the improvement of these conditions. There is an additive effect of engaging in healthful behaviors, with individuals who engage in one healthy behavior such as exercise, often adopting other healthful behaviors such as improving their diet (Paiva et al., 2012). Thus, more research is needed to examine the impact of yoga on other lifestyle behaviors, particularly on diet, levels of physical activity and fitness, and on smoking and alcohol consumption.

Of major concern regarding the use of yoga as preventive medicine are availability and compliance. Currently, yoga seems to be predominantly practiced by wealthy, educated white women in America and Europe. In order to be an effective therapeutic approach to alleviate distress and related health outcomes, there is a need to find methods of attracting and keeping those individuals most at risk for diseases of slow accumulation, particularly individuals who live in poverty or with chronic stress. To achieve this, yoga will have to be adapted to the social and cultural backgrounds of these populations. Thus, it will be beneficial for the next generation of yoga teachers to come from all racial, cultural, and socioeconomic backgrounds. Furthermore, there is a need for longer-term data on the compliance and adherence to yoga practice in underserved populations. Because the widespread use of yoga is somewhat driven by the current zeitgeist, it is unclear if yoga practitioners will show good long-term compliance or if the same behavioral problems will apply as they have to other lifestyle-related and exercise therapies.

One of the best strategies for assisting individuals in adopting a yogic lifestyle and using yoga as a form of preventive medicine would be to incorporate yoga into school and workplace settings. Yoga as primary prevention could be widely introduced in schools and in the workplace because it is easy to practice, relatively safe, and seems to be highly effective in helping individuals cope with the stressful life situations in modern societies. Yoga already has been successfully incorporated into a variety of work settings, including populations of academicians, fire fighters, and health care workers, and yoga has been effective in reducing stress and improving fitness outcomes in these populations (Alexander, 2013; Cowen, 2010; Hartfiel et al., 2012). Twelve research studies have been conducted examining the impact of yoga interventions in school settings and, although the majority of studies have found yoga to be beneficial in relieving stress and improving attention and school performance, most of these studies have been of poor methodological quality (Serwacki & Cook-Cottone, 2012). However, if rigorous studies are performed demonstrating the safety and effectiveness of yoga interventions in children and adolescents in school settings, this would help pave the way for truly incorporating yoga into the daily life of future health care consumers. Yoga then might become an accepted form of preventive medicine that would have a lasting impact on the health and economy at both national and global levels.

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Prevention and Wellness: Clinical Insights

Timothy Mc Call in collaboration with the Consulting Yoga Teachers and Yoga Therapists

Tom Alden says, “Wellness is total health. It is your body, mind, heart, and spirit working together to bring you peace, wisdom, love, and happiness. Wellness in your body brings you a positive experience of life, with a minimum of suffering. You are fit. Your senses work. Your organs support your vitality and physical health. Your nerves, muscles, and bones move you skillfully. Wellness in your mind gives you the ability to think. You can face the unknown, communicate with others, and direct your behavior. It gives you the ability to learn and improvise in the ever-changing world you live in. Wellness in your heart gives you the ability to organize yourself around what’s important to you, and it provides a home for love and kindness.”

”Wellness in your spirit,” Alden adds, “is the source of purpose in your life. While spirit is the least tangible and the least measurable part of you, it is also the most essential aspect of wellness.” In this category, he includes, “awareness, intelligence, vitality, and kindness.” One crucial element of spiritual wellness, he says, is to know “what is important to you and why it is important, so every aspect of you integrates around what you truly want, value, love, and trust.”

Nischala Devi defines wellness as “a wished-for state of being where body, mind, and emotions unite with spirit to allow us comfort and ease in our everyday life.” However, she says, “One would think it would be not only a possibility but also first on everybody’s list of things to be and do.” But that has not been her experience: “Most people do not want to do anything to improve their health until something breaks. Wellness is taken for granted, as a particular right rather than a constantly evolving privilege that needs nurturing and vigilance.”

Ironically, “the benefit that keeps yoga practitioners practicing,” according to Larry Payne, “is the heightened sense of overall well-being that yoga imbues. The feeling of well-being encourages you to continue to practice, and continued practice further heightens well-being, creating a positive feedback loop.” Also helpful, according to Alden, is community, a “network” or team that supports us in wellness. “It’s just too hard to be well alone. We need to be well together.” Therefore, he advises, “Cultivate your community.”

”Of all the people seeking wellness,” Devi says, she has had the greatest effect working with the so-called worried well. These people are essentially in a state of wellness in that nothing major is ailing them, yet they are afraid, perhaps due to their age or family history, of developing incapacitating illness. “Because these clients come well, the practices can be greatly varied. They are able to do more active asana, because there are not the limiting physical restrictions we would experience in a person that has developed disease."

Beyond the physical postures, Devi stresses the importance of "encouraging introspection and quiet practices that enable the client to go deep and if diligent, can continue to improve and sustain a state of wellness for a longer time span. For this client, the stillness of a meditation practice would be emphasized as a route to calm anxiety and recognize wellness." (See Fig. 21.1 .)

"The worried well," Devi says, "can be encouraged after the asana, deep relaxation, and breathing practices to sit quietly and begin a focus on the breath." She often suggests the visualization that the in-breath brings in "fresh revitalizing energy, and the out-breath is a release both physical and emotional. In the silence, a feeling, rather than a thought, of gratitude flows in. Replacing the worries with a sense of gratitude for all they have, including a healthy body and mind."

Abhijit Redij has occasionally seen avid exercisers who come to yoga seeking improved wellness, but "who tend to overdo practices and rush through the program at a pace that does not coincide with the yogic attitude of slow and steady practice." In his experience, "They tend to get bored. Yoga for wellness needs to be tailored so as to bring about moderate changes. Any kind of over-enthusiasm must be discouraged so as to avoid any further complications or injuries."

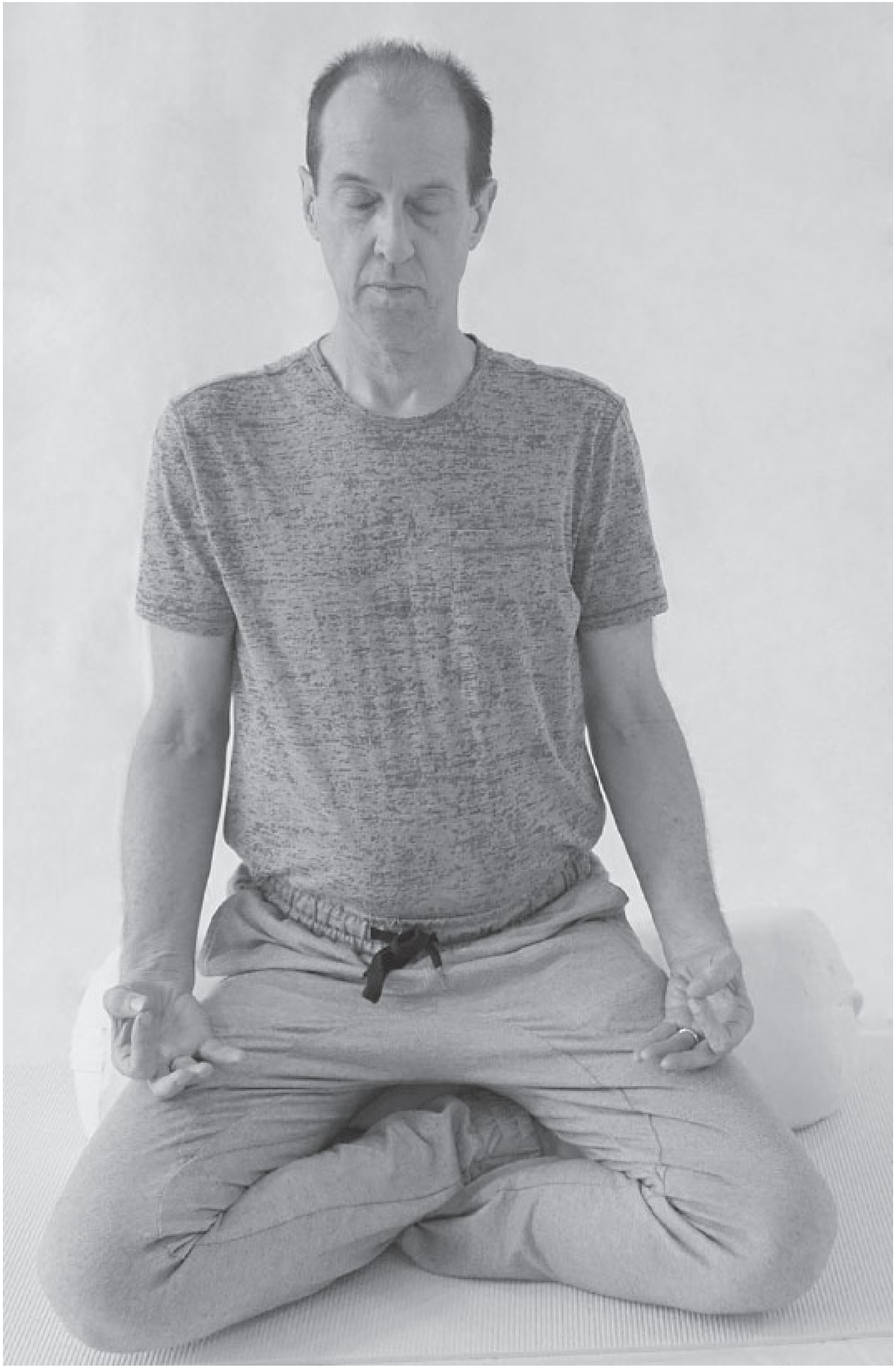


Figure 21.1

Meditation, usually done in a seated position on the floor or on a chair, may be the most important yogic practice for increasing long-term wellness.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Payne asks, “How can you hurt yourself with yoga, if it’s such a health-promoting activity? A major cause is practicing in a manner intended for someone at a different stage of life and physical ability from you.” People know that novice skiers shouldn’t start out on the advanced slopes, “yet, people often plunge into yoga classes without consideration of the style of the practice and its appropriateness for them in their stage of life and style of living. While the popular image of yoga may be of someone contorted into a pretzel-like form, in fact, whether the expression of the pose is pretzel-like or not is of no consequence. It’s the work you do as you progress from wherever you are that grants you yoga’s benefits.” Redij advises gradually increasing the difficulty of practices, but the goal should be “developing awareness and self control.”

Alden agrees. “Train in awareness,” he says. “This begins with calming down. Inner quiet is an important part of wellness. When you calm down, your sensitivity and perceptiveness become more acute. You can then see the details, patterns, and essence in your body, your thinking, and your emotions. Furthermore, in silence, you can hear the voice of your spirit speaking, directing you in how to live.”

”Anyone who has gotten good at something,” Alden says, “knows the importance of practice. To be well, you have to practice healthy actions in each thing you do, whether it’s eating, sleeping, exercising, communicating, or working. When you practice wellness, you come to experience wellness. But wellness does not happen by accident. Life is too complex, stressful, and challenging. To be well, you need to do it on purpose. It needs to be a priority.”

Resources

Book: *The Heart of Yoga* by T. K. V. Desikachar

Book: *Yoga For Dummies* , by Larry Payne and Georg Feuerstein

SECTION 8

PRACTICAL AND FUTURE CONSIDERATIONS

From a collection of 21 opaque watercolor miniature paintings on paper depicting various yogic postures and practices. From the *Bahr al-Hayat* (Ocean of Immortality), Uttar Pradesh, Allahabad, India, 1600–1605. A Persian manuscript that describes 84 different postures. CBL In: 16.26b.

CHAPTER TWENTY-TWO

IMPLEMENTATION OF YOGA THERAPY

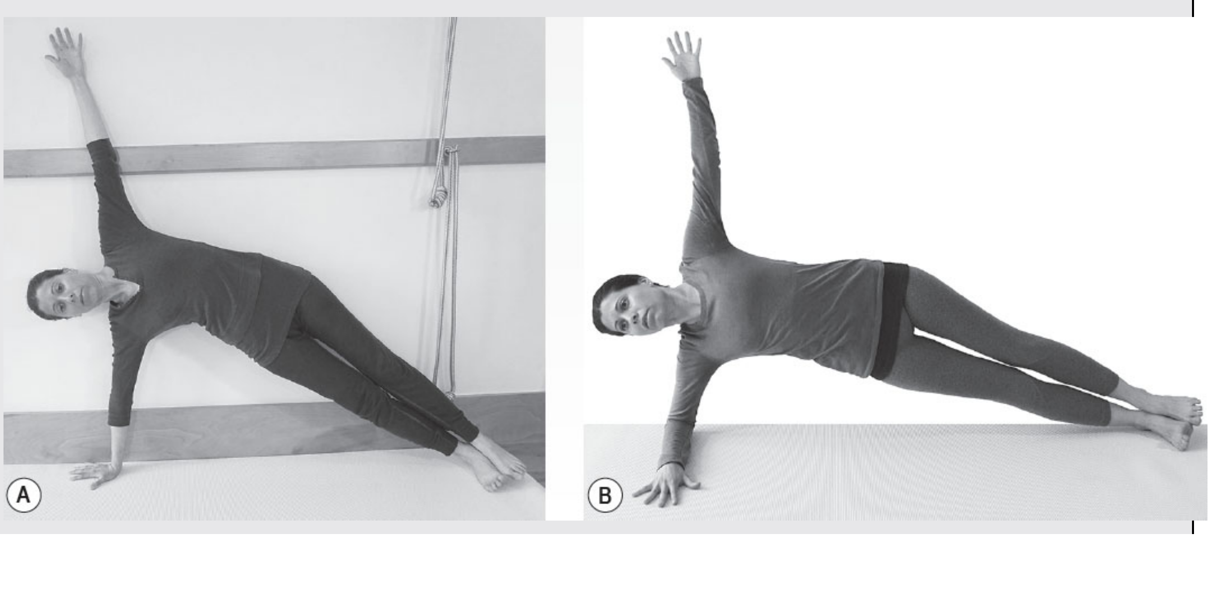
T Mc CALL • L BLASHKI • S TIWARI • J KEPNER • L FISHMAN

Yoga therapy is often conducted through individual consultations and in this way is similar to other health care modalities. Yoga therapy can also be provided in group settings, in which the participants have a similar condition and/or seek similar therapeutic outcomes. In one-on-one settings, the level of assessment can be detailed, allowing for a tailored treatment plan to suit the individual needs of the client; in group yoga therapy sessions, the level of assessment is generally more limited and the treatment plan less individual.

Yoga therapists may work independently, for example, in hospitals, in doctor's offices, or in private practice, and some are part of integrative medicine teams that include other conventional and alternative modalities. Yoga therapists may be "dual-credentialed," that is, trained in medicine, nursing, physical therapy, and so on, in addition to yoga therapy training.

Box 22.1 Yoga therapy: primary or adjunctive?

Yoga is generally a valuable adjunct to medical care, but for several conditions it may be a primary treatment. One example may be scoliosis. In a case series report of 25 patients, Fishman, Groessl, and Sherman (2014) studied patients who performed a slightly modified side-plank pose (*vasisthasana*). After 4.4–6.8 months, the simple “C” curves in more than 90% of patients with degenerative scoliosis were reduced by 30–40%, and the C curves were reduced by 49.6% in patients with adolescent idiopathic scoliosis (Fishman et al., 2014). In contrast, surgery costs $125,000 to $250,000, and requires 1 year of rehabilitation (Kepler et al., 2012). One currently popular procedure for scoliosis, the Cotrel-Dubousset, has a 50% revision rate in the first two postoperative years (Mueller & Gluch, 2012). Tipping the balance further in favor of a yoga approach are the psychological and emotional effects of the different options. Just when young women (aged 12–17) are concerned about the changes in their bodies, a time of life when their intimate impulses are gathering, and when their peer-group is assuming major importance, braces and surgery can cage and incarcerate them. Studies show that self-esteem and body image fall precipitously with medical intervention of either kind (Kinel, Kotwicki, Podolska, Białek, & Stryła, 2012; Misterska, Glowacki, & Latuszewska, 2012; Negrini, Donzelli, Dulio, & Zaina, 2012). However, in other studies of yoga’s effects, self-image and confidence generally rise. (See Fig. 22.1 .)



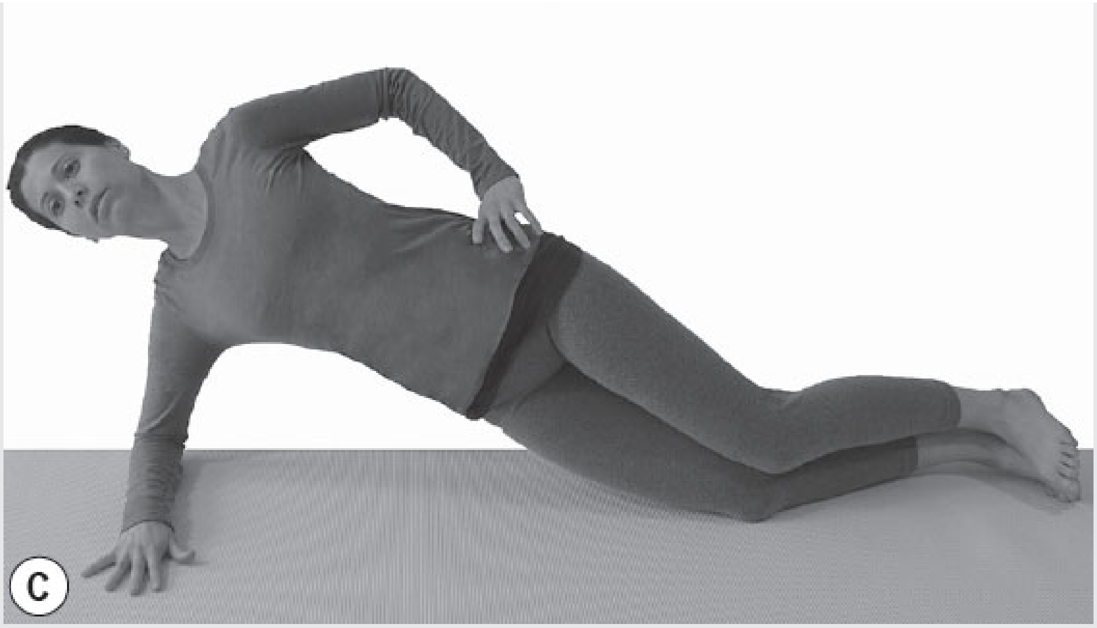


Figure 22.1 A–C
Three versions of *vasisthasana* (side-plank pose) used for scoliosis: (A) practiced against the wall, ideally with the hips a bit lower than shown, to emphasize the lateral bend; (B) a modification for clients with carpal tunnel syndrome, rotator cuff tendonitis, arthritic wrists, etc.; (C) a modification for students with knee and/or ankle pain.

Photographs by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Recommendations and referral guidelines for health care practitioners

Many health care providers are aware of the benefits yoga can bring to patients. However, some remain unsure of the nature of a yoga therapy consultation and how yoga therapy might be included in a patient's treatment plan—or even how to refer a patient to a yoga therapist and what to expect in the process.

A yoga therapy prescription by a physician looks like a physical or occupational therapy referral. It should include diagnosis, goals of therapy, cautions about special conditions that the patient has or might have, the number of sessions per week, and length of time recommended before the patient revisits the referring physician. If the referring physician is knowledgeable about yoga therapy, the prescription may specify desirable and/or contraindicated practices.

As outlined in Chapter 3 , it is important to differentiate between a general yoga class conducted by a yoga teacher and yoga therapy, whether individual or in a group. In developing a referral network, we encourage health care practitioners to speak with those in their locality promoting themselves as yoga therapists, to evaluate their training, competence, experience, willingness and ability to communicate, and trustworthiness.

In addition, yoga therapists can be valuable members of a multidisciplinary case-management team. Direct discussion between the health care practitioner, the yoga therapist, and other practitioners on the team may lead to better outcomes.

Although yoga therapists do receive some education in basic biomedical terminology and pathophysiology, when referring a client to a yoga therapist, simplicity is highly desirable. Complex reports should be summarized in basic language. Patients may be more likely to make an appointment with a yoga therapist and commit to the advice given if their health care practitioner provides a specific referral, rather than simply advising the patient to seek out a yoga therapist.

Typically, yoga therapy consultations include:

1. Conducting an intake interview and/or completing an intake form

2. Assessing the patient’s current health condition, based on yoga therapy principles along with reports from health care practitioners and current treatment, including medications

3. Identifying underlying causes of the presenting condition from the yoga therapy perspective
4. Setting priorities and treatment strategy, in consultation with the client
5. Developing and implementing the yoga therapy program, which may include dietary and lifestyle advice, following yogic (and sometimes ayurvedic) principles.

Yoga therapy usually involves a number of consultations with the yoga therapist. Follow-up sessions allow the yoga therapist to refine the plan, to make sure that the client is practicing the yoga treatment safely and effectively, and to address any new client concerns that may have arisen in the interim. In the process of teaching the routine to the client, the yoga therapist will sometimes determine, through consultation with the client, that the regimen as planned is not quite right for the client, and will make modifications. Whenever possible, details of the yoga evaluation and plan should be shared with the referring clinician.

Yoga therapy consultations are typically several days to a few weeks apart and the client is provided with a program of yoga therapy recommendations to practice (at home, work, or elsewhere). The program may be written, photographed, or provided as audio or video recordings to support the client. Many clients have three or four consultations over a number of weeks. In some instances, a health care practitioner and yoga therapist may believe that a patient is best served by regular therapeutic sessions, possibly meeting once a week over a number of months.

A common challenge in yoga therapy is patient compliance. A few words from the referring clinician may help motivate patients to continue their yoga program. It is also important to remind patients that yoga therapy is usually an adjunctive therapy (see Box 22.1) and that they should continue with their other treatments under the care of their health care practitioners. It is the responsibility of both the yoga therapist and the referring clinicians to reinforce this message.

When yoga therapy is being conducted, the yoga therapist considers what other treatments are already be part of the treatment plan. For example, a patient may be receiving physical therapy for a musculoskeletal injury, part of which includes prescribed stretching. The yoga therapy component of the treatment plan will factor in these stretches to be sure the programs do not counter each other or lead to overwork of any body part. Therefore, in yoga therapy referrals a physician should include other treatments that the patient is receiving (see Box 22.2).

Box 22.2 Interactions of medication and yoga therapy practice

Both referring clinicians and yoga therapists need to be aware of the potential interactions of yoga practice and drug therapy. For example, diuretics, as well as many drugs with anticholinergic properties, increase the risk of orthostatic hypotension, which could present a problem to students quickly rising from the floor or coming out of headstand or handstand. Anti-coagulants increase the risk of hemorrhage in the event of a fall, which would likely alter what a yoga therapist would recommend for asana practice.

It is not uncommon that when people begin to practice yoga regularly their need for medication decreases. The change generally happens gradually over weeks to months but could occur sooner if the students ramp up their practices quickly. The greatest risk in this regard are drugs that lower blood pressure or serum glucose levels, risking syncope and hypoglycemia, respectively. Yoga therapists must focus their serial patient evaluations on these possibilities and send their clients back to the referring physician, or at the very least call the physician if changes are detected or strongly suspected.

If the patient takes analgesics, anti-inflammatory drugs, or similar medications for arthritis or another painful condition, adjustments might be advisable in either the drug schedule or in timing the client's practices to allow therapeutic blood levels to be optimal during yoga. Any exercise, including yoga asana, can bring on asthma attacks in susceptible individuals. If the patient uses an inhaled bronchodilator, have them use it approximately 15 minutes before starting their practice.

Sometimes, the referring clinician will need to choose between yoga therapists from different yoga lineages. While to date there are virtually no comparative scientific studies on which to base such recommendations, some knowledge of different styles of yoga may help in this process.

Existing yoga schools and styles of practice

There are numerous styles and schools of yoga, with new yoga "brands" being created on a regular basis. The following discussion will highlight a few of the major streams, but there is some overlap between the categories. For example, Gitananda Yoga combines *tantra* with some elements of traditional Indian yoga systems. Many yoga teachers and therapists, however, especially in the West, are not adherents of a single yoga system, but rather mix and match the elements of various styles that they find most useful in their own lives and in working with clients. Hatha yoga has become a generic term that describes a wide range of styles, though not everyone uses the term in the same way.

Traditional yoga systems

In India, most of the yoga systems used therapeutically comprise a broad array of yoga tools including asana, pranayama, chanting, meditation, karma yoga (selfless service), vegetarian diet, reading of sacred texts, and devotional practices aimed at gurus and deities. Traditional systems of hatha yoga in India (see Chapter 3) used therapeutically include the style of the Kaivalyadhama Yoga Institute in Lonavla, The Yoga Institute near Mumbai, and an Integrated Approach of Yoga Therapy at the Swami Vivekananda Yoga Anusandhanaa Samsthana (SVYASA) near Bengaluru. Several well-known Indians gurus settled in the West and brought traditional Indian approaches to yoga to Western students, including Kripalu yoga, Sivananda Yoga, and Integral Yoga. The latter, founded by the late Swami Satchidananda (and not to be confused with Sri Aurobindo's Integral Yoga), has been involved in yoga therapy for decades. Integral Yoga uses a standard sequence of poses that is taught in most classes, but modified in those with a therapeutic focus. The gentle approach and the lack of hands-on adjustments make this form of yoga quite safe. Yoga therapy in this tradition is often done in group classes aimed at people with specific conditions, for example, yoga for arthritis and chronic pain, and Dr Dean Ornish's Program for Reversing Heart Disease, which does not include any reading of texts or devotional practices.

Alignment-based yoga styles

B. K. S. Iyengar, and the style of yoga he developed, Iyengar Yoga, strives for proper and safe anatomical alignment in poses. Pranayama practices are taught only after the student has attained proficiency in asana. Iyengar pioneered the use of props such as blocks, bolsters, straps, and benches, as well as ropes mounted to either the wall or the ceiling to enable relative beginners to practice poses safely and effectively while better approximating proper alignment. Props allow students who lack sufficient flexibility or strength to do the poses with good alignment and with less risk of injury. They also help increase bodily awareness, and allow more experienced students to penetrate more deeply into a pose. Props are essential to perhaps Iyengar’s most important innovation in yoga therapy—restorative yoga. In restorative poses (for examples, see Chapter 17), the props support the student almost entirely, allowing the student to rest while assuming the proper form of the pose. They are particularly helpful for students who are weak or tired from disease or as a consequence of treatment. They are also valuable during menstruation and in periods of high stress or at any time when a student or client is in need of a deep rest.

A few schools created by Iyengar’s former students reflect his focus on proper alignment, including Purna Yoga, Anusara Yoga, and Sun-Jeevan Yoga, a system from Pune, India, dedicated to therapeutic work. Given the emphasis on precise alignment, these systems can be useful to students with musculoskeletal conditions, though they treat the full gamut of other conditions as well. Mr Iyengar’s focus on alignment has been influential in the West, spreading to many other yoga systems in the past few decades.

Krishnamacharya yoga

Sometimes referred to as Viniyoga, yoga in the style of T. Krishnamacharya (see p. 34), was propagated by his son T. K. V. Desikachar. Although B. K. S. Iyengar was also Krishnamacharya's student, Viniyoga is very different than Iyengar yoga, the main difference being the focus on the breath and its coordination with movement. Viniyoga incorporates specific breathing practices and sometimes chanting into asana practice, for example, instructing students to inhale as they lift their arms, then to chant a mantra as they fold forward into a pose. As with most other styles of yoga, this option would only be offered to students who are open to chanting; it is never forced on an unwilling student. The poses tend to be gentle, with students moving repeatedly in and out of them, sometimes holding the poses for a few breaths. Because the movements are never forced and the poses are held for short periods of time, the risk of injuries is very low, making this style particularly well suited to older students and those with serious illnesses. It is important to remember that many vigorous asana styles, such as Ashtanga Yoga, Power Yoga, and vinyasa flow, are offshoots of the yoga system Krishnamacharya developed for young boys, and which his students spread to the West (see Chapter 3), but these styles are very different from the gentle approach he used therapeutically. Svastha Yoga, a therapeutic style developed by A. G. Mohan—another of Krishnamacharya's long-time students—is similar to Viniyoga and is offered both in Chennai, India, and in some Western countries.

Tantra

Tantra is a pragmatic yoga style that uses the widest possible array of yogic tools, from asana and pranayama to mantra, visualization, and meditation. The popular guided visualization, yoga nidra, is a tantric technique. Tantric approaches often also include cleansing practices, such as lavaging the nasal passages with warm saline via a neti pot, as well as ayurvedic dietary and lifestyle advice. Tantra is generally safe when learned under the direct guidance of a good teacher, but should not be undertaken, it is said traditionally, without proper oversight. Gitananda Yoga and yoga in the style of the Bihar School of Yoga (see Chapter 3) are well-known Indian tantric traditions, which can be used therapeutically, and these can also be found in some Western countries. Integrative Yoga Therapy is a therapeutic approach started by Western students of Gitananda Yoga. One school that is well known in the West, with a long-standing involvement in yoga therapy, is Kundalini Yoga as taught by Yogi Bhajan. In this style, many tools may be combined, with a student, for example, simultaneously moving the arms up and down, breathing through alternating nostrils, chanting a mantra, and moving the fingers into various *mudras* (gestures). Other tantric traditions in the West sometimes used therapeutically include Ishta Yoga, TriYoga, Para Yoga, and Himalayan Institute Yoga.

Contraindications and cautions in yoga therapy

As with any health care intervention, a clinician should weigh the risks versus the benefits of yoga therapy. Therapeutic yoga, as opposed to general yoga classes, particularly vigorous ones, appears to be extremely safe. In contrast to most classes, in yoga therapy the strenuousness of the practice is titrated to each student. Beyond medical conditions, the yoga therapist factors in the client's overall level of fitness, stamina, frailty, and specific needs and desires for therapeutic outcomes.

Given the nature of yoga therapy as a holistic mind–body practice, there are no overall contraindications to yoga therapy per se. Not all yoga therapy involves physical postures (asana) or breath work (pranayama), although these practices are commonly a part of treatment strategies. It involves providing only what the client needs and is capable of practicing.

Good yoga teachers and yoga therapists routinely ask their students if they have any medical conditions or injuries they should know about. Unfortunately, even when a teacher asks a student point-blank, some vital information may remain undisclosed. A good yoga therapist, however, can often sense something even when the client does not speak up, reading his or her client's subtle bodily cues, such as changes in posture or respiration. Yoga teachers will notice when a student is struggling with a practice, noting a slight grimace, tentativeness in a movement, or a hitch in the breath. Indeed, the quality of the breath is often the single most important barometer of safety in yoga practice.

The following list of contraindications and cautions can help guide the referring clinician as well as the yoga therapist. However, there can be no definitive list of contraindications, since medical conditions vary in intensity and their possible combinations and interactions are infinite. Further, each student or client brings to yoga a unique combination of strengths and weaknesses. Therefore, there is no substitute for caution. An experienced yoga therapist thinks about each patient and each condition and observes the client practicing before making determinations of what should be safe and what may not be.

Almost all contraindications are relative and can often be circumvented with judicious use of props and/or modifications of the pose. Sometimes techniques that are contraindicated in theory are safe in practice. Poses that are clinically inappropriate at one stage of an illness may actually be indicated later on. Furthermore, the same practice can be done in very different ways, some contraindicated, others fine. So, for example, downward-facing dog pose may generally be inappropriate for someone with carpal tunnel syndrome, but if it can be taught in a different way that keeps the carpal tunnel more open, the pose can be therapeutic.

To date, there has been almost no scientific study of yoga contraindications. The cautions below are based on the direct experience of yoga teachers and yoga therapists, the pathophysiology of the various disease processes, and common sense. In general in yoga therapy, following the principle of *ahimsa* (nonharming), it works best to follow the maxim "when in doubt, leave it out." Almost every benefit that could be gleaned from one yoga practice can be had from other yoga practices. The skillful yoga therapist therefore chooses practices to maximize the potential benefits while minimizing the risk of harm. The nomenclature below follows (mostly) that of B. K. S. Iyengar's book *Light on Yoga* (Iyengar, 1995).

Spinal conditions

Cervical disc herniation

Avoid weight-bearing on the head, as in headstand (*sirsasana*). Avoid extreme flexion, as in shoulderstand (*sarvangasana*) and plow pose (*halasana*). For some patients with cervical issues, headstand practiced hanging from ropes (see Fig. 22.2) or balancing between two chairs may offer similar benefits to the full pose and may even be therapeutic for the neck due to gravitational traction. Committed students sometimes install wall ropes in their home practice spaces.

Facet syndrome

Extreme extension of the spine will often worsen this condition, since paraspinal muscular spasm is usually (some say always) involved, and extension transfers the weight back on the facet joints.

Hyperkyphosis of the thoracic spine

The lower back is often injured because the thoracic spine remains overly kyphotic, tempting practitioners to hyperextend the lumbar spine, for example, in upward-facing dog pose (*urdhva mukha svanasana*) and camel pose (*ustrasana*). Similarly, the cervical spine can hyperextend in compensation for limited thoracic mobility, for example, in cobra pose (*bhujangasana*) and corpse pose (*savasana*). In the latter case, it may be necessary to place folded blankets or other props under the head and/or the neck. Caution should be used with forward bends, which may encourage more thoracic rounding.

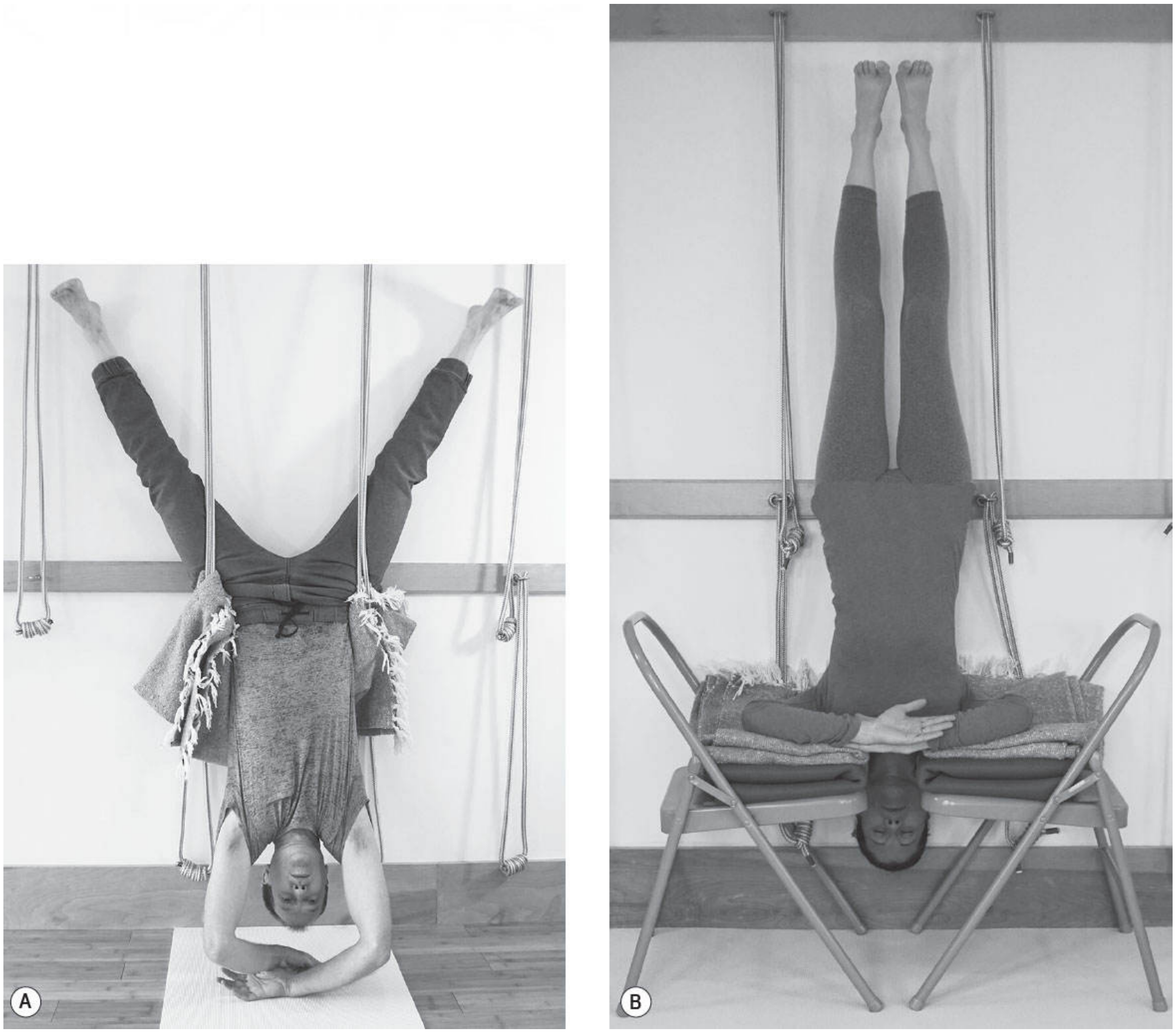


Figure 22.2 A, B

Two variations of *sirsasana* (headstand) for students with neck problems: (A) hanging from ropes, in this variation with wide legs and (B) with shoulders supported by two chairs.

Photographs by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Low-back pain

Contraindications depend on the location and, in the case of injuries, the mechanism of the injury. Herniated lumbar discs may become permanently worsened by forward bending and by flexion to the side of the lesion. Caution is advised in the use of strong, forced exhalation as in *bhastrika* and *kapalabhati* . Students with a postural habit of flattening or reversing the normal lordotic lumbar curve may need to avoid forward bends or only do versions with concave lumbar spine rather than full convex versions. They should avoid leg lifts, *navasana* (boat pose), and *bakasana* (crow pose). Students with hyperlordorsis (sway back) need to exert caution with backbends such as *bhujangasana* (cobra pose) and *utkatasana* (chair pose) that may encourage overarching (see Fig. 22.3). Fast-paced classes with rapid movement from pose to pose (for example, power yoga, vinyasa flow) may be risky because the student may not have enough time to avoid less-than-optimal postural alignment habits.

Figure 22.3
Modified version of *urdhva muhka svanasana* (upward-facing dog pose) to make it less strenuous and easier to maintain a healthy lumbar curve.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Lumbar disc herniation

Avoid forward bends especially seated and standing forward bends or only do versions with concave (extended) lumbar spine rather than full convex (flexed) versions. Supine forward bends such as knees-to-chest pose (*pavanamuktasana*) are usually well tolerated. Seated forward bends, particularly if there is also an element of twisting involved as in head-to-knee pose (*janu sirsasana*) can compress nerve roots, extend herniation, and aggravate sciatica. Strong twisting, especially seated and especially to the side of the herniation, may increase symptoms and worsen the underlying condition. While lumbar extension is usually therapeutic, occasionally extension can exacerbate and possibly even cause disc herniation.

Neck pain

Contraindications depend on the underlying cause/mechanism of injury. Avoid headstand, shoulderstand (*sarvangasana*), and plow pose (*halasana*). Avoid extremes of cervical flexion, extension, twisting, and lateral bending. Avoid looking up, arching neck in backbends like cobra (*bhujangasana*) and *ustrasana* (camel pose) and other backbends. In poses like *trikonasana* (triangle pose), *vasisthasana* (side plank), avoid turning head toward ceiling. In twists, do not twist the cervical spine, but instead keep the head facing the same direction as the chest (see Figs 22.4 and 22.5).

Figure 22.4
A chair under the feet, in addition to the folded blankets under the shoulders, makes this version of *halasana* (plow) pose easier on the neck.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Figure 22.5
Looking straight ahead in *trikonasana* (triangle pose), as opposed to toward the ceiling, lessens the stress on the neck.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Scoliosis

Avoid practices that increase the stretch on the already over-stretched side, for example, in right thoracic scoliosis avoid lateral poses that increasing the bowing of the right lateral ribcage. Headstand (*sirsasana*) may be inappropriate, depending on the degree of curvature and the student's ability to work with his or her asymmetry. In some students, rope *sirsasana* (if available) may be a good substitution.

Spondylolisthesis

Avoid deep twisting postures except when the whole trunk is fully supported on the floor. Avoid compressive movements such as jumping forward into *uttanasana* from *adho mukha svanasana* (downward-facing dog pose). Avoid moderate or extreme extension (backbending) in anterolisthesis; avoid rounding of the lumbar spine in retrolisthesis.

Spinal stenosis

Generally avoid backbends, which can further narrow the spine up to 63% (although occasionally they may be therapeutic).

Other musculoskeletal conditions

Achilles tendonitis

Avoid poses that stretch the Achilles tendon, including downward-facing dog pose (*adho muhka svanasana*), especially with the heels on the floor. Avoid bent-knee standing poses such as warrior (*virabhadrasana*) I and II or extended side-angle pose (*parsvakonasana*) I and II. Avoid jumping in sun salutations (*surya namaskar*), and other jarring movements.

Adhesive capsulitis

Tolerating mild shoulder pain with poses that gradually increase range of motion is probably desirable. However, limit pain to leave student’s motivation undiminished.

Ankle sprains/strains

Take care in standing poses, especially in one-legged balancing poses. *Padmasana* (lotus pose) and poses with one leg in *padmasana* may increase strain on the joint, as may those that require extreme plantar flexion with body weight on the dorsum of the foot, for example, *vajrasana* (thunderbolt pose). Come out of inversions with care or lead with the other foot until healing is complete.

Anterior and posterior cruciate ligament tear

In an anterior cruciate tear, avoid postures with extreme knee flexion such as *virasana* (hero pose) and postures that place rotation strain at the knee joint, such as *padmasana* (lotus pose), *siddhasana* (accomplished pose), and *janu sirsasana* (head-to-knee pose). In posterior cruciate problems, avoid *marichyasana* I and II. Exert care with standing poses, especially those that involve rotation, such as *trikonasana* . Avoid jumping from pose to pose. With posterior cruciate problems, avoid hyperextension of the knee joint in all poses.

Carpal tunnel syndrome/wrist pain

Avoid weight bearing with wrists extended, as in many arm balances, including handstand, and to a lesser degree downward-facing dog pose. Modifying the poses to allow the wrists to be in neutral alignment may be well tolerated. Blocks are helpful for maintaining neutral alignment. Use caution with extreme pronation or supination of forearms, which may increase symptoms.

Dupuytren's contracture

Cautions are the same as for carpal tunnel, but in addition, use caution with half-moon pose (*ardha chandrasana*) when affected hand is weight-supporting, and eagle pose (*Garudasana*).

Knee derangement

Squatting poses such as *malasana* (garland pose) and *utkatasana* (chair, or powerful, pose) may increase shearing forces in the knee joint. *Virasana* (hero's pose) may be inappropriate, particularly with joint swelling. Exert care with poses like *vajrasana* (thunderbolt pose) and child's pose (*balasana*) in which the knees are in full flexion (padding the area behind the knee may help). One-legged balancing poses may put too big a load on the joint. Kneeling poses like *ustrasana* (camel) and cat/cow may be painful (padding on the floor may help). If the front knee is not aligned directly over the ankle in such poses as warrior (*virabhadrasana*) I and II, the knee joint can be strained. Attempts to strengthen the vastus medialis obliquus with standing poses run into trouble when the problem is a meniscal tear or an anterior or posterior cruciate ligamentous sprain. Other standing poses are potentially dangerous in these conditions. Avoid *padmasana* (lotus pose), especially in lateral collateral ligamentous sprain, jumping from pose to pose, and hyperextension of knee joint in all poses.

Hamstring tear

Exert caution with forward bends, particularly with legs spread wide, for example, *upavista konasana, prasarita padottasana* . Avoid hyperextending the knees in all poses (see Fig. 22.6).

Lateral Epicondylitis

Use caution with strong gripping of the hands, in which extension pulls on the forearm's flexors and aids the intrinsics of the hand to grasp more tightly, which occurs in many yoga poses such as twists, in which hands clasp, and forward and back bends, where hands grasp feet, such as *supta padangusthasana* .

Figure 22.6
Wide-legged forward bends can exacerbate hamstring tears. This variation with the chair and folded blankets under the forehead lessens the pull on the hamstrings and makes the pose more restorative.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Osteoarthritis

Long holds of poses may increase stiffness and pain, especially if the poses are difficult. Long holds done with ease or repeatedly moving in and out of poses may be helpful. Avoid weight-bearing poses early in practice sessions in hip arthritis. One-legged balancing poses may put too big a load on hips, knees or ankles. Limit cervical extension to tolerance, but increasing range of motion with gradually progressive extension may be helpful.

Osteoporosis/osteopenia

Forward bends with a convex spine can cause compression fractures. These poses appear to be safe with a concave spine, hinging at the hip. Avoid poses with risk of injuries from falls. Judicious use of props such as walls and chairs for support and blankets for padding can mitigate the risk of injury. Avoid headstand, shoulderstand, and plow pose. Avoid jumping from pose to pose.

Piriformis syndrome

Precautions (rather than contraindications) are postures that emphasize external rotation of the thigh, except pigeon pose or poses with more than 90-degree hip flexion, where the piriformis becomes an internal rotator. Some twists, for example, *jathara parivartanasana* (revolved-abdomen pose), may increase strain on the lower back because of piriformis spasm and increase sciatic pain (though some students report the opposite experience). Intense hip-stretching seated poses such as *gomukhasana* (cow-face pose) may be painful (see Fig. 22.7).

Plantar fasciitis

During the acute phase, the student may need to avoid all standing poses and straight-legged forward bends. Later, the student may need to pad the heel. The student should avoid jumping from pose to pose and should avoid any poses that cause pain in the foot.

Rheumatoid/inflammatory arthritis

If joints are acutely inflamed, the student should rest until the condition has cooled down. Avoid heating breaths such as *bhastrika* and *surya bhedana* (sun-piercing breath). Avoid yoga in hot/humid conditions. Gently moving in and out of poses may be safer than sustained holds, but avoid too many repetitions.

Rotator cuff tendonitis/bursitis

Avoid resisted external or forced internal rotation of the shoulders as in c*haturanga dandasana* (yoga push-up), *urdhva dhanurasana* (upward-bow pose), *gomukhasana* (cow), and *parsvottanasana* . Use caution with weight-bearing by the arms as in arm balances like crow pose (bakasana, *adho mukha svanasana* (downward-facing dog), and *vasisthasana* (side-plank pose). Any poses in which the arms are abducted near 90 degrees may exacerbate symptoms (standing poses can be done with the hands on the waist instead of raised). Do not attempt to strengthen abduction or flexion in the rotator cuff early on. Due to the inflammatory nature of the condition, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*) and yoga in hot or humid rooms.

Figure 22.7
The supine twist *jathara parivartanasana* (revolved-abdomen pose) can be problematic in some cases of piriformis syndrome.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Sacroiliac strain

Use caution with forward bends, particularly those with an element of twisting, for example, *janu sirsasana* (head-to-knee pose). Twists can exacerbate symptoms, including standing poses like *trikonasana* (triangle pose) that entail some twisting. Use caution with most wide-legged postures, such as *upavista konasana* , because abducting the legs presses the sacroiliac (SI) joints together. If the hamstrings are unequal in length, exert caution with symmetrical forward bends such as *paschimottanasana* (seated forward bend). Vinyasa-flow practices, rapidly linking poses without a focus on alignment, can exacerbate SI strain.

S/P knee replacement

Avoid one-legged standing poses because they may put too much weight on the knee. Avoid jumping from pose to pose, or other practices that may cause jarring to the affected leg. *Virasana* (hero pose) and *triang mukhaikapada paschimottanasana* (three-limbed seated forward bend) are absolutely contraindicated. Approach lotus pose gradually and with extreme care to first improve hip range of motion.

S/P hip replacement

Contraindications depend on the surgical approach used, making it necessary to determine what was done. In general, to avoid the risk of dislocation do not go to the end of range of motion in all planes of hip movement, especially flexion, adduction, and internal rotation taken together (for example, as in tying a shoelace). With the more traditional posterior (or posterior lateral) surgical approach, avoid hip flexion past 90 degrees, internal rotation as in poses like hero's pose (*virasana*), and femur adduction past the midline as in *ardha matsyendrasana* . With the anterior or anterolateral approach, the patient should avoid extreme hip movements in extension as in strong backbends and lunge poses, external rotation of femurs as in lotus (*padmasana*) and pigeon (*eka pada rajakapotasana*), and abduction as in *upavista konasana* and *prasarita padottanasana* . In both anterior and posterior approaches, movements that combine the movements described above are particularly risky. For example, *garudasana* (eagle pose) combines adduction, flexion, and some internal rotation and is contraindicated in posterior surgical approaches (see Figs 22.8 and 22.9).

Thoracic outlet syndrome

Inversions such as headstand, shoulderstand, and plow pose and forward bending poses can sometimes increase symptoms. Forward bends with a concave lumbar spine and axial extension of the thoracic spine may be better than convex forward bends. Use caution with *jalandhara bandha* (throat lock) and cervical hyperextension (see Fig. 22.10). Protracting the shoulders, as in improperly done eagle pose (*garudasana*) and *matsyendrasana* is contraindicated, since it tightens the brachial plexus and proximal nerves at the underside of the clavicle and the coracoid process.

Figure 22.8
Adduction of the femur past the midline in *ardha matsyendrasana* (half lord of the fishes pose) makes it potentially risky in some patients after hip replacements using posterior surgical approaches.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Figure 22.9
Abduction of the femurs makes *prasarita padottanasana* (wide-legged standing forward bend) potentially risky after hip replacements using anterior approaches.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Patellofemoral pain syndrome/chondromalacia patellae

Kneeling poses such as *ustrasana* (camel pose) may be uncomfortable (padding with cushions/folded blankets with kneecaps in front of the blankets may lessen pain). Poses in which the knees take considerable weight, such as the pigeon pose (*kapotasana*) variations, can be dangerous without padding. Avoid any practices that increase knee pain (limiting degree of knee flexion may help).

Cardiovascular conditions

Cardiac arrhythmias

Avoid internal breath retentions, that is, holding the breath after inhalation. Also, take care with *viloma* I and II in atrial fibrillation.

Carotid body and carotid sinus disorders

Caution (or perhaps contraindication) is advised with full inversions such as headstand, handstand, and shoulderstand (*sarvangasana*) and extreme back bends, such as *urdhva dhanurasana* .

Congestive heart failure/pulmonary edema

With peripheral edema, inversions may increase venous return and exacerbate fluid overload. However, in small doses, gradually increased as tolerated, inversions can be helpful in mild to moderate congestive heart failure. Salt in a neti pot (nasal lavage) could be problematic with fluid retention. Supine postures such as *savasana* (corpse pose) should be propped so student is not lying flat for lengthy periods (see Fig. 10.2B).

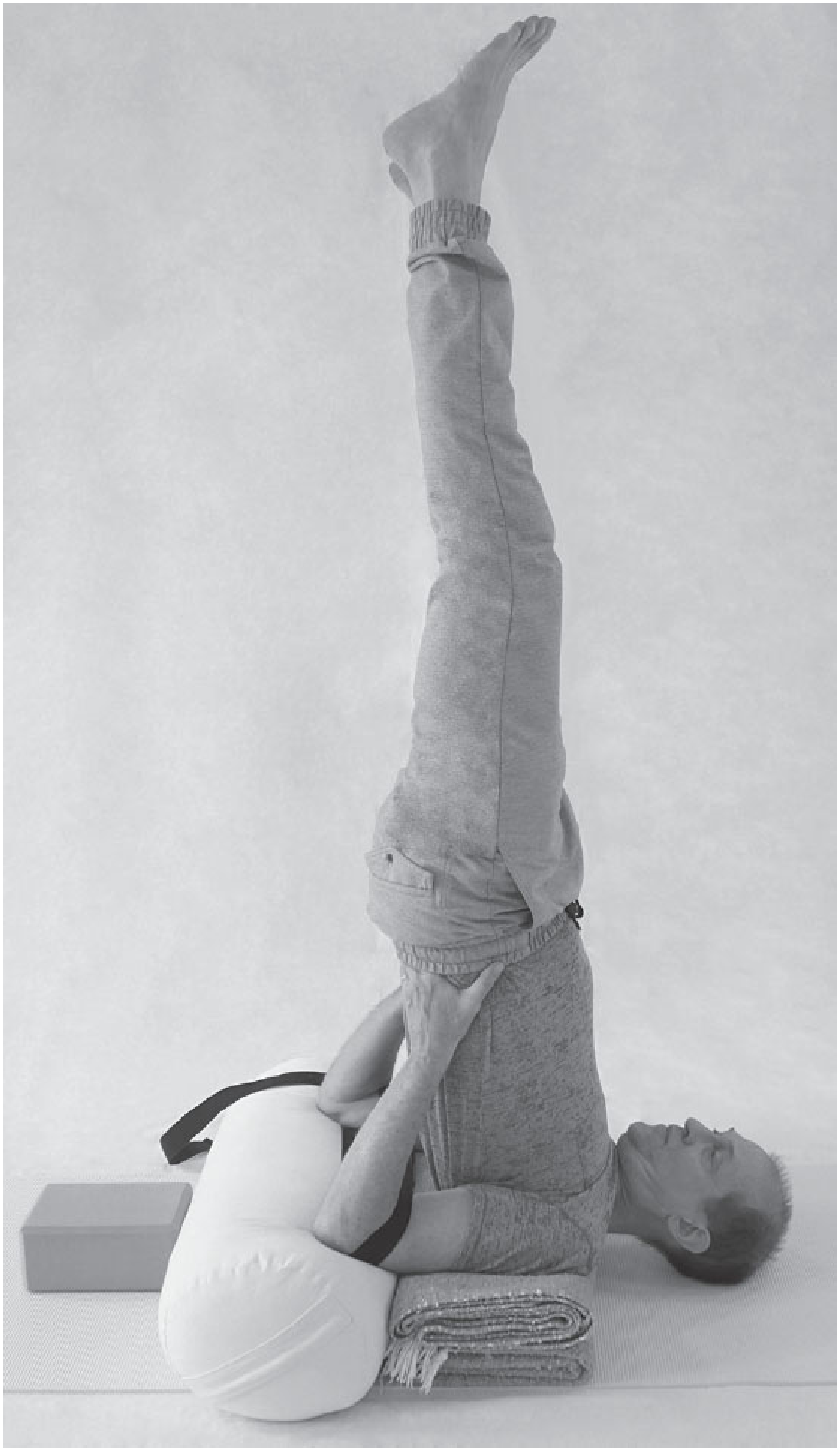


Figure 22.10
In this modified *sarvangasana* (shoulderstand), blankets under the shoulders allow the student to maintain a normal cervical curve, the bolster under the elbows helps with tight shoulders, and the strap helps keep the elbows from splaying to the sides. *Jalandhara bandha* (chin-to-chest position) is a natural part of shoulderstand, but the student is subtly moving the chin away from the chest to help maintain a healthy cervical curve.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Coronary artery disease/angina

Hot/humid conditions and vigorous vinyasa practices (for example, Power Yoga) place greater demand on cardiac output. Avoid dehydration, because it can lead to hemoconcentration. Avoid breath holding/Valsalva maneuver. Avoid *agni sara* and *nauli* . Use caution with ratio breathing at low respiratory rates, strong pranayama practices, for example, *kapalabhati* and *bhastrika* . Use caution with any physically demanding asana, including standing poses, arm balances, or any positions with the arms held overhead or abducted to 90 degrees, because work increases greatly in performing these exercises. Avoid *sirsasana* (headstand) and handstand. It may be necessary to avoid or modify shoulderstand (sarvangasana). Watch for inadvertent breath holding (see Fig. 22.11).

Hypertension

Avoid breath holding, particularly after the inhalation. Avoid strong pranayama practices such as *kapalabhati* and *bhastrika* . Headstand, shoulderstand and other fully inverted postures and arm balances may increase blood pressure (BP) transiently, and should be avoided in those whose hypertension is not well controlled (with more experienced students, a regular practice of inversions may help to lower BP). Avoid any poses that require a sudden burst of energy to achieve, including *urdhva dhanurasana* (full backbend), *pincha mayurasana* (forearm balance), and handstand, all of which are backbends. Use caution with backbends and other practices that stimulate the sympathetic nervous system. Take care with strong abdominal poses such as *navasana* (boat pose) and supine leg lifts, though *supta padangustasana* with a strap on the leg is fine. Use caution with *agni sara* and *nauli* , as well as standing poses with arms overhead or abducted to 90 degrees. Even if BP is well-controlled, some students may find that strong backbends, arm balances, inversions, and even normally calming pranayama practices such as *ujjayi* (victorious breath) bring on agitation, in which case they should be modified or avoided. Generally, avoid lengthy periods of demanding asanas, for example, rest for three or four minutes after every 10 minutes of strong poses (see Fig. 22.12).

Figure 22.11
Keeping the hands on the waist, as opposed to overhead, in *virabhadrasana* (warrior) I makes it less taxing on the heart.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Hypotension/orthostatic hypotension

Use caution with full forward -bending postures from standing, such as *uttanasana,* and hands overhead postures such as *urdhva hastasana* . Avoid breath retention after the exhalation. Care should be taken when coming out of inversions and when coming up from the floor. Avoid coming up from a forward bend with a concave spine or lifting the arms overhead (it may be better to roll up *slowly* with the arms at the sides). Use caution with yoga in hot/humid conditions because this may increase the risk of dehydration and peripheral vasodilatation. Fast-paced classes, for example, Ashtanga Yoga, vinyasa flow, may not allow enough time between poses to adjust to orthostatic changes in BP.

Figure 22.12
Supta padangustasana (supine hand-to-big-toe pose) with a strap on the foot is generally safe in hypertension. This modification with the right knee bent makes the pose more accessible to some students with tight hips.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Varicose veins

Use caution with long holds of cross-legged seated poses, lotus pose (*padmasana*), and poses with one leg in *padmasana* , and other poses that may constrict blood flow in the legs. Prolonged kneeling or standing may exacerbate varicose veins (it is better to repeatedly move in and out of poses).

Vasovagal disorder

Use caution with full forward-bending postures from standing, such as *uttanasana* . Take care with transitions that involve orthostatic changes, for example, moving from floor to standing. Use caution with *uddiyana bandha* (upward abdominal lock), *nauli* , and inversions such as headstand, shoulderstand, and handstand (especially immediately after coming out of the pose), and even partial inversions such as *adho mukha svanasana* (downward-facing dog pose). Use caution coming out of long holds of poses. Watch for inadvertent breath holding.

Neurological conditions

Cerebrovascular disease

Avoid hyperextension of the cervical spine as in *ustrasana* (camel pose) (see Fig. 22.13) because this can compress the vertebral arteries. With atherosclerotic disease in the carotid arteries, avoid strong twisting and lateral flexion of the neck, full *jalandhara bandha* (chin-to-chest position). In twists, keep the face pointing in same direction as the chest, that is, do not turn the neck. Avoid inversions. Use caution with strong breathing practices, which may elevate BP.

Epilepsy

Use caution with strong pranayama practices such as *kapalabhati* and *bhastrika* . Generally, there are no contraindications if seizures are well controlled, but it is best to avoid practices that could lead to overexertion, dehydration, or hyperthermia, all of which could lower the seizure threshold. If seizures are not well controlled, take care to avoid practices where falling is a risk, for example, standing poses and inversions, due to the risk of injury, particularly head injury.

Migraine

Titrate practice in line with symptoms. In acute headache, only restorative or relaxation practices may be possible. Use caution with full inversions such as shoulderstand (*sarvangasana*) and backbends if experiencing symptoms (otherwise, these are potentially well tolerated). Avoid starting strong practices without adequate warm up to avoid triggering a headache. Avoid dehydration, another common trigger. Use caution with strong neck rotation.

Figure 22.13

In this modification of *ustrasana* (camel pose), a bolster makes the backbend less extreme. Notice that the student is not hyperextending her neck.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Multiple sclerosis

Yoga in hot/humid conditions may decrease nerve conduction and increase symptoms. If balance is a problem, avoid practices where falling is a risk. Judicious use of props such as walls and chairs for support and blankets for padding can mitigate risk. People with multiple sclerosis (MS) and other neurological conditions should exert caution with any poses that require a sudden burst of energy to come into the pose, including *urdhva dhanurasana* (full backbend), *pincha mayurasana* (forearm balance), and handstand, all of which are backbends. Strong pranayama practices such as *kapalabhati* (skull-shining breath) and *bhastrika* (bellows breath) can increase fatigue. Many people with MS tend to push themselves too hard, and they should be encouraged to work within a comfortable range in all practices.

Figure 22.14
Placing a chair under the front thigh in *virabhadrasana* (warrior) II pose makes it safer and easier for students with balance problems.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Parkinson's disease

If balance is a problem, avoid practices where falling is a risk, such as headstand. Judicious use of props such as walls and chair for support and blankets for padding can mitigate risk, for example, *vrksanana* (tree pose) can be practiced standing next to a wall, *virabhadrasana* I (warrior I) can be done with the front thigh on a chair. If thoracic hyperkyphosis is present, avoid *halasana* (plow pose) and *karna pidasana* (knee-to-ear pose). Full forward bends with a convex spine may increase kyphosis (with a concave spine, hinging at the hips is generally well tolerated). (See Fig. 22.14 .)

Peripheral neuropathy

Use caution with all postures that require tactile sensitivity in hands and feet and with headstand, handstand, and other poses where the student could be injured coming out of pose. Avoid jumping from pose to pose or other potentially jarring practices. Be careful not to leave stray props on the floor, as an injury could result for a student with peripheral neuropathy of the feet.

S/P cerebrovascular accident

Cautions and contraindications depend on the nature of the neurological deficits, but caution should be applied in all strenuous practices. If balance is a problem, avoid practices where falling is a risk. Judicious use of props such as walls and chairs for support and blankets for padding can mitigate risk. Use caution with inversions such as headstand and shoulderstand, in which the head is lower than the chest, including partial inversions such as downward-facing dog pose, and *uttanasana* (standing forward bend). Avoid hyperextension of the cervical spine in *ustrasana* (camel pose) and similar poses because this can compress the vertebral arteries. Avoid strong twisting and lateral flexion of the neck and full *jalandara bandha* (chin lock) with atherosclerotic disease in carotid arteries. In twists, keep the face pointing in the same direction as the chest, that is, do not turn the neck. Avoid strong pranayamas, including *bhastrika* and *kapalabhati* .

Spinal cord injuries

Beware the possibility of practices causing or exacerbating pressure sores (use padding to support weight-bearing areas). Use caution if the student has any orthopedic hardware such as screws, plates, rods, and so on that restrict movement. If osteoporosis is present, exert caution with any weight bearing that risks fracture. In patients with an injury at T6 or above, be aware that a strong stimulus below the level of injury can result in autonomic dysreflexia, resulting in dangerous hypertension. Use caution with strenuous practices, because these students with spinal cord injuries can be unintentionally violent with their bodies. If physically deconditioned, increase practice intensity slowly. Avoid yoga in hot/humid conditions if thermoregulatory functions are impaired.

Respiratory conditions

Asthma

Backbending may be painful during an asthma attack and generally should be avoided. Between attacks, backbends are generally fine and even advisable. Use care with poses that compress or limit ribcage movement, for example, *paschimottasana* (seated forward bend), *janu sirsasana* (head-to-knee pose), and strong twists. Avoid breath holding, particularly after inhalation, and strong breathing practices such as *kapalabhati* (breath of fire). Watch for inadvertent breath holding. Caution with postures where the face is near the floor, mat, blanket, or other prop, for example, *bhujangasana* (cobra pose), due to possible exposure to allergens (see Fig. 22.15).

Chronic obstructive pulmonary disease (COPD)

Avoid internal breath retentions and slow respiratory rates (appropriate level to be determined individually). During exacerbation of the disease, avoid inversions, which put weight on the diaphragm, though they may be helpful in times of respite. Avoid *agni sara* and *nauli* . Avoid strenuous practices and any practices that increase breathlessness. Avoid strong pranayamas, including *bhastrika* and *kapalabhati* . Watch for inadvertent breath holding. Avoid strenuous yoga in hot/humid conditions. Use caution with strong forward bends and *kumbhaka* .

Sinusitis

Inversions, even partial inversions such as *uttanasana* (standing forward bend), may increase pressure sensations in the head and sinuses. Use caution with alternate-nostril breathing (*nadi shodhana*), or other pranayamas that use unilateral nostril breathing, when one side is fully occluded.

Upper respiratory tract infections

It is best to rest during the early stages of a cold. Supine poses, gentle pranayama, meditation, and restoratives may be well tolerated. Inversions may increase pressure sensations in the head/sinuses but may also transiently increase blood flow and relieve nasal congestion. Use caution with alternate-nostril breathing (*nadi shodhana*), or other pranayamas that use unilateral nostril breathing, when one side is fully occluded.

Figure 22.15
Janu sirsana (head-to-knee pose) can be problematic in patients with sacroiliac strains, anterior cruciate tears, and asthma. The chair in this modification makes the pose more accessible for less flexible students, and leaves more room for the ribcage to move with the breath.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Female reproductive conditions

Menopause

Strong backbends, arm balances, and abdominal work, for example, may bring on hot flashes. If osteoporosis or osteopenia are present, take precautions as described on page 497.

Menstruation

Avoid inversions in which the heart is lower than the pelvis, especially during the first few days of the menstrual period, because this may interfere with the natural downward movement of *apana vayu* (see page 42) and the egress of blood. Avoid *uddiyana bandha, agni sara,* and *nauli* . If feeling tired, avoid all strong practices, for example, standing poses, intense backbends and twists, and vigorous sun salutations (*surya namaskar*), especially during the first few days of the period.

Pregnancy

Yoga in hot/humid conditions is not recommended. Avoid strong practices that lead to exhaustion. Avoid breath retentions. Most teachers avoid inversions such as headstand and shoulderstand except with students who already have a regular practice of these poses before their pregnancy. Ligaments become more pliable due to hormonal changes (relaxin), and therefore care should be taken to not stretch too far into poses, perform strong physical adjustments in poses such as *baddha konasana* (cobbler's pose), or try and increase range of motion, because joint instability could result. Use caution with rapid flowing from pose to pose, for example in vinyasa practice, because it may be difficult to maintain healthy alignment, which risks overstretching of ligaments. Avoid prone backbends or other poses in which the abdomen is one the floor. Avoid arm balances, jumping from pose to pose, leg lifts, and strong abdominal work that could increase the risk of diastasis (rectus abdominis separation at the linea alba). Avoid strong twisting poses, which may separate the placenta from the uterine wall.

1st trimester

Avoid all strenuous practices, and any strong twists, due to an increased risk of miscarriage. Avoid abdominal contractions in any poses. Avoid supine poses with the back flat on the floor; elevate the chest with a bolster or blankets.

2nd trimester

Avoid any forward bends, for example, *paschimottanasana, balasana* (child's pose), and twists that compress the area of the uterus. Avoid *tadasana* (mountain pose) and especially forward bends with feet close together (that is, widen the legs to make room for the abdomen). Do not lie flat on the back or on the right side, due to possible compression of the inferior vena cava (*savasana* can be done lying on the left side with support (see Fig. 22.16)). Avoid twists (except *bharadvajasana* , which can be done on a chair), including some poses with a strong element of twisting, for example, revolved triangle pose (*parivrtta trikonasana*).

Figure 22.16
Lying on the left side is safer than supine or on the right side after the first trimester.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

3rd trimester

Precautions for 2nd trimester apply. Separate feet in *tadasana* and forward bends even further (may want to also stand with feet slightly turned in to widen back of pelvis). Late in pregnancy (for example final 6 weeks), women doing headstand and shoulderstand may want to stop practicing them (though some women have continued without problems). Avoid poses with risk of falling, due to risk of injury to mother and/or baby.

Post-partum

Due to the lingering effects of relaxin (lasting several months after delivery, longer if breastfeeding), ligaments are more pliable, and therefore care should be taken to not stretch too far into poses, do strong adjustments, or try to increase range of motion, because joint instability could result. If the linea alba separates, avoid peacock pose (*mayurasana*), leg lifts, and other strong abdominal work, and exert caution with arm balances and forward bends. Be careful with practices that may overly stimulate the sympathetic nervous system, such as repeated vigorous sun salutations, strong backbends, and *kapalabhati* breathing, especially in new mothers, who may already be anxious. If depression develops, follow precautions from that section (see p. 510).

Gastrointestinal conditions

Diarrhea

Strong twists may increase symptoms. If diarrhea is inflammatory in nature, or if the patient is dehydrated, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. In acute gastroenteritis, avoid all strenuous practices (restoratives and gentle breathing practices may be tolerable).

Constipation

Inversions may exacerbate constipation. Twisting poses may be uncomfortable (but also potentially therapeutic).

Inflammatory bowel disease

Due to the inflammatory nature of the disease, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. Strong twists may increase diarrhea.

Inguinal hernia

Baddha konasana (cobbler's pose) and backbends such as *ustrasana* (camel pose), may increase herniation. Avoid arm balances, *mayurasana* (peacock pose) and other practices that increase intra-abdominal pressure. Take care with deep twists, for example, revolved side-angle pose (*parvritta parsvakonasana*) due to the possibility of ischemia/strangulation of herniated tissue. Other standing poses may also increase intra-abdominal pressure, and should be practiced with care. Avoid *navasana* (boat pose) and *raja kapotasana* (king pigeon pose). Avoid prone backbends such as cobra (*bhujangasana*), locust (*salabhasana*), and other poses with the abdomen on the floor (see Fig. 22.17).

Figure 22.17
Bhujagasana (cobra) and other poses in which the abdomen in on the floor can be problematic in patients with inguinal hernias.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Reflux esophagitis

Inversions may increase symptoms. Even relatively mild inversions such as standing forward bend *uttanasana* and downward-facing dog pose may cause problems. Practices such as *uddiyana bandha* (upward abdominal lock), *agni sara,* and *nauli* , which are said in yoga to bring the *prana* (life force energy) upwards, can exacerbate reflux. *Mayurasana* may induce symptoms, as can arm-balancing poses like *bakasana* (crow pose) and other poses that increase intra-abdominal pressure. Strong lateral bending and twists can also bring on or exacerbate symptoms, as can strong backbends such as *urdhva danurasana* (upward-bow pose). In marked reflux, even supine poses like *savasana* (corpse pose) may cause symptoms (elevating the chest and head can help). It is best to drink no fluids an hour or more before or during practice. Do not eat for 4–5 hours before practice or practice first thing in the morning. Due to the inflammatory nature of the condition, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. Avoid *bhastrika* and *kapalabhati* pranayama (see Fig. 22.18).

S/P colostomy

Prone positions, for example, *bhujangasana* (cobra pose) and *salabhasana* (locust pose) may be difficult. Creative use of blankets and other props can mitigate risk. Use caution with arm balances, *mayurasana* (peacock pose) and other practices that increase intra-abdominal pressure.

Figure 22.18
Even partial inversions such as *adho muhka svanasana* (downward-facing dog pose) can exacerbate reflux. In this

variation, the pose is made more restorative by supporting the head with folded blankets.

Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Endocrine conditions

Diabetes

There may not be any contraindications if the patient has not developed any complications from diabetes and has good glycemic control. In type 1, avoid all asana other than restoratives and relaxation if blood glucose is greater than 300, or if greater than 250 and ketones are present. Be aware that strong practices and increased practice time can lower blood sugar in those taking medicines such as insulin that can cause hypoglycemia (a greater concern in type 1 diabetes). In diabetic neuropathy affecting the feet, avoid jumping (from pose to pose), inversions such as headstand and shoulderstand in which the feet could be injured coming into or falling out of the pose. In severe neuropathy, use caution practicing in bare feet (consider having the patient wear “yoga socks” or shoes, ideally ones dedicated to this purpose so they remain clean) due to risk of injury. Be careful not to leave stray props on the floor, as an injury could result if stepped on. In diabetic autonomic neuropathy, avoid strenuous asana practices. Avoid yoga in hot/humid rooms. Eat long before starting yoga session if gastroparesis is present. Exert caution coming up from forward bends or inversions due to risk of dizziness/syncope. In diabetic retinopathy, avoid all strenuous asana, straining, breath holding, and jumping from pose to pose. Avoid full inversions such as headstand, and exert caution with partial inversions such as *uttanasana* (standing forward bend) and downward-facing dog pose. In diabetic nephropathy, avoid all strenuous asana and pranayama practices.

Hyperthyroidism

Due to the inflammatory nature of the disease, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. Caution with *sarvangasana* (shoulderstand) because, according to the yoga tradition, it can stimulate the thyroid.

Hypothyroidism

Generally none, unless marked disease, for example, myxedema.

Eye conditions

Glaucoma

Avoid full inversions, especially headstand and handstand, which have been found to double intraocular pressure (Baskaran et al., 2006) in 15 to 30 seconds (Intraocular Pressure During Inversion: http://sciatica.org/yoga/inversion_and_eyes_2.html). Shoulderstand and such partial inversions as *viparita karani* (legs up the wall pose), downward-facing dog pose (*adho muhka svanasana*), *uttanasana* (standing forward bend), cause milder increase in intraocular pressure.

Macular degeneration

Use caution with inversions, as for glaucoma, especially for wet disease.

Myopia (extreme)

Use caution with inversions especially headstand, handstand, *pincha mayurasana* (forearm-balance pose).

Retinal detachment/tear

Use caution with inversions, as for glaucoma. Avoid jumping from pose to pose or other jarring movements.

Psychological conditions

Anorexia nervosa

Use caution with any strong physical practices, because there can be a tendency for some patients with eating disorders to exercise excessively. Be gentle with praise and corrections, so as to not fuel self-flagellating, perfectionist attitudes. Avoid having the student practice in front of a mirror, because this may prevent the student from going into an internal experience of the body and breath.

Anxiety

Strong backbends, lateral poses, and strong breathing techniques such as *kapalabhati* may lead to agitation and increased anxiety. Use caution with handstand in acute anxiety, because it can be overly stimulating. Any practice that prolongs inhalation or that focuses on breathing through the right nostril may prompt agitation. Even normally calming pranayama practices such as *ujjayi* (victorious breath) are unsettling to some people with anxiety.

Bipolar disorder

If in depressive phase, follow the precautions in the following section on depression. If taking lithium, exert caution with yoga in hot/humid conditions due to the risk of heat intolerance and/or dehydration. If the student is manic/hypomanic, avoid strong breathing practices such as *kapalabhati* and *bhastrika* , and exert caution with strong backbends and/or lateral poses and handstands, which may be too stimulating.

Depression

Forward bending and asanas and other practices in which the eyes are closed sometimes lead to marked dysphoria, as can postures that create a “fetal-like” position, such as *balasana* (child’s pose) and *halasana* (plow pose). Some practices, such as *savasana* and meditation, usually done with closed eyes, can be done with the eyes open to mitigate dysphoria. In agitated depression, precautions in the section on anxiety may apply. Meditations that are ungrounding or too internalizing may depress mood or lead to increased dysphoria, as can left-nostril breathing. If taking medications with anti-cholinergic side effects, for example, tricyclic antidepressant medication, take care with transitions in postures because orthostatic hypotension may cause light-headedness.

Posttraumatic stress disorder/trauma

Some yoga poses may put students in a psychologically vulnerable position, for example, *savasana* (corpse pose) in a woman with a history of childhood sexual abuse (though if the patient can be made to feel safe, or can work with the emotions, it can be therapeutic). Use caution with vigorous asana practices, strong backbends such as *urdhva dhanurasana* (upward-bow pose), strong pranayama practices such as *kapalabhati* (skull-shining breath) and *bhastrika* (bellows breath), which can lead to autonomic hyperarousal and provoke mental agitation and anxiety and potentially precipitate a flashback. Take care that the milieu is neither threatening nor too “friendly,” for example, with excess or unwanted physical proximity or contact from other people, including the yoga teacher or yoga therapist.

Schizophrenia

Exert caution with strong pranayama practices, for example, breathing with long breath retentions and/or low respiratory rates, and some meditation techniques, particularly if done for long periods of time, may lead to dissociation. If student is taking antipsychotic medication, take care with transitions in postures because orthostatic hypotension could cause light-headedness.

Narcissistic and borderline personality disorders

Be gentle with praise and corrections, so as to not fuel self-flagellating or self-aggrandizing attitudes. Avoid practicing in front of mirrors as this may prevent students from going into internal experience of the body and breath.

Miscellaneous conditions

Sickle cell anemia

If starting out, build up practice time and exertion levels slowly over weeks to months. Caution with strenuous practices, yoga in hot/humid conditions because dehydration could contribute to a sickle cell crisis.

Balance problems

Avoid poses with risk of injuries from falls. Judicious use of props such as walls and chairs for support and blankets for padding can mitigate risk.

Blood coagulation problems

Use caution with inversions and balancing poses where falling and resultant injury is a risk.

Cancer

Contraindications depend on diagnosis, stage, and current treatment regimens. In extreme fatigue or severe anemia (hemoglobin less than 8 g/dL), forgo all active practice in favor of restoratives, relaxation, supine breathing, and/or meditation. In colorectal cancer, avoid practices that increase intra-abdominal pressure, for example, arm balances, *mayurasana* (peacock pose), and exert caution with *uddiyana bandha, agni sara* and *nauli* . In bone metastasis to spine, caution with forward bends, inversions (see osteoporosis). For discussion of lymphedema see page 512 . In cancer survivors, there may not be any contraindications to yoga, but it is best to build up slowly, letting the current situation (not pre-cancer abilities) dictate what is appropriate. Patients with an indwelling catheter may need to modify postures to avoid dislodging it. Survivors with ostomies should avoid practices that increase intra-abdominal pressure and those that are done lying prone.

Chronic fatigue syndrome

Overwork could lead to a rebound in symptoms, so always titrate practice to the student’s energy level during each practice session. Even restorative backbends such as *viparita karani* and *supta baddha konasana* may be problematic in severe cases of chronic fatigue syndrome, though if tolerated can be therapeutic. Strong backbends and lateral poses may be too stimulating, as may be strong *pranayama* practices such as *kapalabhati* (skull-shining breath) and *bhastrika* (bellows breath), which can, paradoxically, increase fatigue.

Fibromyalgia syndrome

Overwork may lead to a rebound in symptoms, so always titrate practice to the student’s energy level during each practice session (that is, do not base the practice solely on what they have been able to do before). Avoid practices that increase pain or which lead to agitation of the mind or nervous system.

Headaches

Avoid inversions and cervical spine hyperextention (extension may be therapeutic). Use caution with strong practices in general, holding standing pose for long periods (for example, greater than 1 minute), sun salutations (*surya namaskar*), and jumping from pose to pose. Avoid strong breathing practices such as *kapalabhati* . Even strong *ujjayi* (victorious breath) may exacerbate.

Hepatitis

Due to the inflammatory nature of the disease, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. If the patient has a fever, avoid all strenuous practices.

HIV/AIDS

No contraindications in asymptomatic HIV infection. If symptomatic or out of shape, start slowly and increase efforts slowly, as tolerated. Aim for moderate exertion and length of practice sessions, because excessive exercise may depress immune function.

Insomnia

Caution with stimulating practices, for example, strong backbends, balancing poses, repeated sun salutations (*surya namaskar*), vigorous *pranayamas* , for example, *bhastrika* (bellows breath), yoga in hot/humid rooms 2–3 hours before bed. Tolerance varies, so titrate in accordance with the student’s experience.

Lupus vulgaris

Contraindications vary with different presentations. Due to the inflammatory nature of the disease, avoid overly heating practices, for example, repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms. Avoid high-impact practices, for example, jumping from pose to pose, and overly strenuous practices.

Lymphedema

Avoid putting the affected body part in a dependent or weight-bearing position, for example, in a woman with a history of axillary dissection due to breast cancer, downward-facing dog and arm balances put the affected extremity at risk. Avoid strenuous exercise and yoga in hot/humid conditions, which may increase edema. Avoid rapidly increasing the workout level (it is better to progressively build up tolerance).

Obesity/overweight

Avoid any poses that put undue weight on particular joints, for example, arm and one-legged balancing poses. Headstand may put too much pressure on the spine. Handstand may be hard on the arms and shoulders, and injury may occur coming or falling out of the pose. Shoulderstand may be particularly difficult for women with large breasts.

Otitis media

Inversions, even partial inversions such as downward-facing dog pose and *uttanasana* (standing forward bend), may increase pressure/pain in the ear. If feeling ill, avoid all strong asana and breathing practices. Due to the inflammatory nature of the condition, avoid overly heating practices, for example repeated sun salutations (*surya namaskar*), yoga in hot/humid rooms.

Renal failure

With peripheral edema, inversions may increase venous return and exacerbate fluid overload. Salt in a neti pot (nasal lavage) could contribute to fluid retention. Please see contraindications for heart disease, hypertension, and/or diabetes if any of these are also present.

Vertigo

Caution with standing forward standing bends such as *uttanasana* , backbends such as *ustrasana* (camel pose) where the head is well posterior to the anatomical neutral position, and full twists of the cervical spine (twisting from the rest of the spine may be tolerated if the neck stays neutral, that is, with the nose and sternum facing in same direction). Avoid abrupt changes in head position in any plane. Avoid working toward the end of range of motion in cervical flexion/extension, twisting, and lateral movements. Exert caution in poses such as headstand and one-legged balancing poses, where falling is a risk (judicious use of props such as walls and chair for support and blankets for padding can mitigate risk).

Vital exhaustion/burnout

Overwork could lead to an exacerbation of symptoms. Even restorative backbends such as *viparita karani* and *supta baddha konasana* may be problematic. Strong backbends and lateral poses may be too stimulating, as may be strong pranayama practices such as *kapalabhati* (skull-shining breath) and *bhastrika* (bellows breath), which can, paradoxically, increase fatigue.

Injuries

Although yoga therapists do everything possible to prevent injuries in their clients, a major responsibility for yoga safety falls on the client. In yoga, students work to build their proprioceptive abilities, and in most instances practices that are contraindicated (or simply inappropriate) will not feel good on some level. Many people have been accustomed from previous exercise to push forward when they get the first indications that something is not agreeing with them ("no pain, no gain"), but this mentality is antithetical to yoga practice. Therefore, part of a yoga therapist's work is to determine when a client is likely to push too hard or ignore early warning signs that a particular practice may not be safe. This is especially a concern in group classes, where students often feel the need to do what everyone else in the room is doing, even when they know better. Despite the generally greater vulnerability of those receiving yoga therapy as compared with students in general yoga classes, who tend to have fewer health challenges, the medical knowledge of yoga therapists and the one-on-one nature of the treatments appears to *lower* the risk of injuries.

Box 22.3 Common yoga injuries and asanas in which the injury occurred

From a survey of 33,000 yoga practitioners (Fishman, Saltonstall, & Genis, 2009).

- Neck – *sirsasana* (headstand), *sarvangasana* (shoulder stand), *halasana* (plow pose)
- Shoulder/rotator cuff – *chaturanga dandasana* (yoga push-up), *adho mukha svanasana* (downward-facing dog pose), *vasisthasana* (side-plank pose), *urdhva dhanurasana* (upward-bow pose, or full backbend)
- Lower back/sacroiliac joint – seated and standing forward bends, twists, backbends
- Knee – *virabhadrasana* warrior I and II (warrior pose I and II), *trikonasana* (triangle pose), *padmasana* (lotus pose), *eka pada rajkapotasana* (one-legged king pigeon pose), *virasana* (hero's pose)

Perhaps the leading cause of yoga injuries is over-efforting (see Boxes 22.3 , 22.4 and Fig. 22.19). Students often push to achieve the outward form of a pose—trying to emulate their teachers or a photo from a magazine—even when their body and breath are telling them they are not ready yet. In general, if the breath remains slow and steady throughout the practice, in and out through the nose, the risk of injury appears to be small.

As students become more experienced in yoga, they begin to be able to differentiate the kinds of pain that are safe to work with, as with the mild ache in the body of a hamstring felt during a forward-bending pose, from more worrisome symptoms, as when a sharp pain comes to the knee joint in a standing pose. It is normal, particularly for people who are unaccustomed to yoga, to feel a little sore the day after a strong practice. Muscle achiness after a practice is generally not of concern, but it should quickly resolve. However, joints should never hurt more than usual during or after practice. If they do it could indicate poor anatomical alignment of bones or muscles in one or more poses, or that the person is simply doing more than they are ready for. Some students may feel fine physically after a practice but may feel spaced out or agitated and unable to sleep. This again is a sign of having overdone things or having done a practice that is not well suited to them. On the basis of such feedback, the yoga therapist will usually adjust the practice to avoid the problem going forward, and sometimes recommend other practices to help remedy it.

Box 22.4 Areas of the body most likely to sustain a yoga-related injury

From a survey of 33,000 yoga practitioners (Fishman et al., 2009).

On a scale of 0 (never) to 5 (most frequent).

- Low back 3.79
- Shoulder or rotator cuff 3.23
- Wrist or hand 3.13
- Knee 3.05
- Hip problems 2.69
- Hamstring 2.57
- Neck 2.47
- Headaches 1.99
- Groin strain 1.56
- Lower leg or foot 1.50
- Pregnancy issues 1.24
- Thoracic or rib pain 1.04
- Bruise from fall 0.96
- Cardiac problems 0.81
- Fracture 0.56

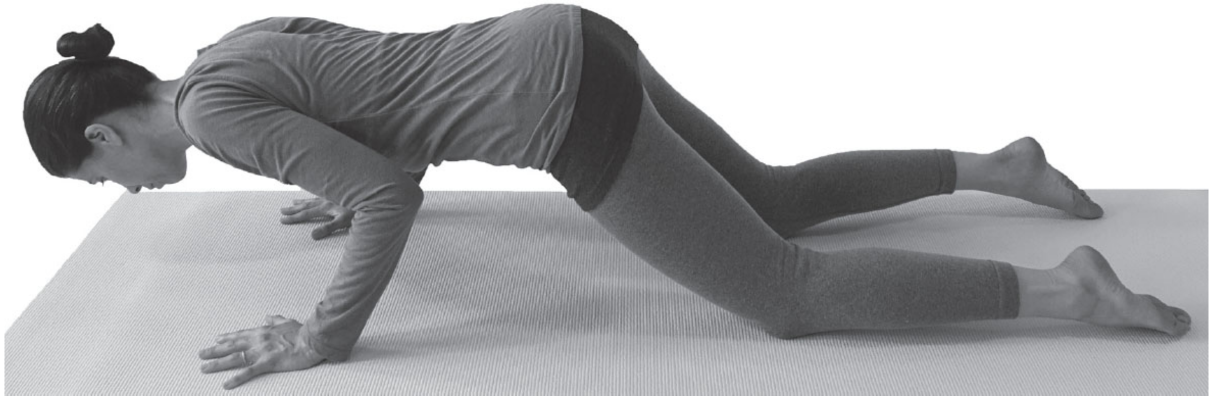


Figure 22.19
Chaturanga dandasana (four-limbed staff pose, aka yoga push-up) is one of the riskiest poses for the shoulders. This modification with the knees on the ground makes it easier to maintain healthy shoulder alignment.
Photograph by Maria Moreira courtesy of the Simply Yoga Institute, NJ, USA

Safety considerations with pranayama and meditation

According to ancient yoga texts, breathing practices, done improperly, are among the riskiest yoga tools. Because of the intimate connection between the breath and the autonomic nervous system, yoga teaches that the student must start pranayama slowly, particularly if any volitional breath holding is involved, and progress slowly. Except for the most basic breathing techniques, it is best to be guided by an experienced teacher. In general, in all pranayama techniques, the student should never become short of breath, have air hunger, gasping, rough breathing, or become agitated or have difficulty focusing their attention during or after an exercise.

Meditation may not be appropriate (or even possible) for people who are acutely anxious or depressed, though a regular meditation practice may be one of the most powerful tools to promote psychological well-being over the long term. Anyone with clinical depression, a history of schizophrenia, or other serious psychological problems should consult a mental health care professional knowledgeable about mind–body practices before beginning a meditation practice. Guided meditation exercises like *yoga nidra* may be better tolerated than self-directed efforts, at least initially. Some people become anxious or are confronted with a flood of unwanted emotions if they try to meditate (though sometimes this release may be therapeutic). If problems arise, working with a yoga teacher experienced in meditation and, if necessary, with a psychotherapist, can be helpful. Gradually building up time in meditation is prudent.

Although the most serious adverse effects related to pranayama and meditation are on the mind and the nervous system, structural problems can result. Many people, unaccustomed to sitting on the floor for long periods, tuck their pelvis bones (posteriorly rotate) and flatten or reverse their lumbar spinal curve, potentially leading to back pain. The solution in most instances is to sit on enough cushions or folded blankets to allow a normal lumbar curve. Knee, hip, and ankle problems can also arise from prolonged sitting if anatomical alignment is not good. Many yoga therapy clients may be best off seated in a chair, though here too attention to alignment is crucial, which the skilled yoga teacher or therapist can provide.

Safety of yoga in hot and humid conditions

Some yoga classes, most notably Bikram Yoga and classes billed as “hot yoga,” the room is heated in excess of 100˚F (38˚C). With many people sweating profusely, it is likely to also be quite humid. While the conditions may facilitate going deeper into poses, they also may elevate the risk of dehydration, increased blood viscosity, and myocardial infarction. Although hot yoga is sometimes billed as a cure-all, and anecdotes of its healing properties abound, such conditions seem unduly risky for patients with MS, epilepsy, chronic fatigue syndrome, fibromyalgia syndrome, and inflammatory conditions such as lupus or Crohn’s disease, during pregnancy and for anyone with or at risk of lymphedema.

Dehydration from profuse sweating could contribute to heat stress or heat stroke (hyperthermia), particularly in those who have not yet acclimatized to the conditions or who are already relatively dehydrated (for example, from drinking alcohol the night before). Acclimatization is most safely accomplished by building up slowly over a matter of several weeks. If the student takes a break from practicing hot yoga, he or she may need to start the process of acclimatization all over again. Since a persistently elevated heart rate is often the first sign of dehydration, it may be advisable to have the student monitor their pulse during class, and drink fluids before, during and afterwards.

Standards for the practice of yoga therapy

In the early twenty-first century, some members of the yoga therapy field realized the importance of establishing comprehensive educational standards in order for yoga therapy to become a recognized and respected part of health care systems. Mirroring earlier work by the Australian Association of Yoga Therapists, in 2009 the International Association of Yoga Therapists (IAYT) began this process. In 2011, the British Council on Yoga Therapy followed suit. With over 3,500 members and 140 schools in 48 countries, IAYT is the world's largest professional yoga therapy association. The IAYT standards process is a classic effort in self-regulation by an emerging field. The intent is to:

> … establish a variety of structures in order to promote safe and effective practice, strengthen the field's legal status, expand professional opportunities, increase the profession's political influence and legitimize a field in the eyes of potential students, governmental entities and the healthcare industry. Self-regulatory structures can also set the groundwork for professional licensure and other types of external recognition.
>
> (Seitz, 2010, p. 28)

A Standards Committee was established by IAYT consisting of international leaders in the field, and after nearly 3 years of work, the Educational Standards were endorsed by the IAYT board of directors and published online in 2012 (International Association of Yoga Therapists, 2012). The Standards are competency-based and focus on entry-level requirements for the training of yoga therapists. Programs must be at least 800 hours and taught over a minimum of 2 years. The minimum admission requirement is the successful completion of a basic 200-hour yoga teacher training program. Although schools are free to teach principles consistent with their own lineage and methodology, for their programs to be accredited by IAYT they are required to demonstrate that they teach and assess all the competencies in the Educational Standards and have qualified faculty. Schools also have to show evidence of sound business practices for professional training programs. At the time of this writing, IAYT is developing policies and procedures for certifying yoga therapists, which will be granted either by graduation from an IAYT-accredited program or through a limited-term process of grandparenting.

In 2012, the Council for Yoga Accreditation International (CYA International) was started by representatives of many of India’s top yoga therapy institutions, as well as a few traditional yoga organizations located in the West. According to their website (CYA International, 2015), “Only institutions are members of the Council, and individuals awarded certification by such accredited institutions may be submitted by the institution to the Council for loading in the searchable database.”

It should be noted, however, that not all yoga teachers and therapists favor a certification or licensure process or plan to take part in it. Some worry about bureaucracy, politics, and other intrusions into their style of practice.

Applicability of yoga therapy research to clinical practice

Most yoga research is still attempting to answer the question of whether yoga therapy works at all, and answering this question scientifically—and affirmatively—is vital to the project of bringing yoga more into health care. Few studies to date, however, give clues about how to refine the practice to make it better or to compare the efficacy of one practice or one yogic school to others, limiting their usefulness to practicing yoga therapists.

In accordance with the tenets of evidence-based medicine, virtually all yoga therapy research to date has employed standardized treatment protocols determined by the medical diagnosis (or in patients with multiple diagnoses, one of their diagnoses). As detailed in Chapter 3 , this is not the way most yoga therapists work. Instead, yoga therapists perform a detailed holistic evaluation of the client and, based on what they have observed, craft an individualized program.

The yoga therapy process is based on the understanding that persons are unitary beings, in which each part is interconnected with the whole and with every other part. Yoga therapists like to say, “We don’t treat conditions—we treat people.” Although a patient’s medical diagnosis influences the practices that a yoga therapist will recommend, with a few exceptions (mostly in orthopedic conditions), it does not determine them. In practice, the diagnosis is often the most helpful in determining which yoga practices may be contraindicated.

As the client’s condition evolves, the yoga therapy program may be continually modified, and sometimes completely revamped. Such ongoing changes in protocol, routine in practice, are generally not allowed in scientific studies. Further, long-term students go deeper and deeper into their practices in a way that studies have not attempted to examine. Thus there are major gaps between what has been studied and what good yoga therapists actually do.

Complicating matters, unlike surgery, drug therapy, therapeutic massage, Pilates, or the South Beach diet, and so on, yoga has a spiritual dimension, which is a powerful (if not *the* most powerful) impetus toward healing, but one that beyond self-reports may require unorthodox means to study. But if spiritual endeavors such as meditation have not a therapeutic effect for particular conditions, that effect can be measured.

In addition, protocols of yoga programs in research studies are usually crafted based on the practices and principles of a particular teacher or style of yoga. Different schools of yoga have slight (or major) variations in the way they teach particular practices yet may refer to them by the same name. Conversely, some traditions teach essentially the same practices but label them differently. Published research studies do not necessarily mention the school of yoga followed, nor the procedures employed and instructions given to the participants while performing each asana, breathing technique, and so on. Some research studies only describe the intervention as a “yoga program.” Practicing yoga therapists would be better served if future research studies elaborate on the nature of the yoga intervention along with details of the instructions used.

It is incumbent upon researchers (and those who fund research) to develop creative ways to begin to bridge the gaps between what is studied in yoga research, what is reported in research papers, and how yoga therapists actually work.

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CHAPTER TWENTY THREE

FUTURE DIRECTIONS IN RESEARCH AND CLINICAL CARE

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Bibliometric analyses of yoga research have shown a wide range of disorders that have been evaluated in clinical trials. Most trials have focused on the major health disorders, including depression, anxiety, cardiovascular diseases, and respiratory conditions (Cramer, Lauche, & Dobos, 2014; Jeter, Slutsky, Singh, & Khalsa, 2015; Khalsa, 2004). As yoga and yoga therapy have undergone an exponential increase in popularity, there has been a parallel increase in research on yoga and yoga therapy. Some research areas have undergone greater growth than others. Perhaps the most striking example has been the research on yoga in cancer patients. A bibliometric analysis on yoga therapy research published in 2004 reported only four such papers, with two of the citations published in 2004 itself (Khalsa, 2004). A recent update of this analysis has revealed a total of 47 publications (Jeter et al., 2015), a more than 10-fold increase in less than a decade. There have also been a growing number of reviews and meta-analyses on yoga for cancer, with four meta-analyses published from 2011 to 2012 alone. As the volume of research on major disorders has increased in quantity, there has also been (and will likely continue to be) an increase in the disease subtypes and symptoms being evaluated.

Evaluation of yoga for additional disorders and populations

With the growth in interest and credibility of yoga as a therapy, there is also an increasing number of conditions evaluated in yoga clinical trials that have previously not been studied, a trend that will likely continue. In fact, some of these disorders may not have been considered as addressable with a yoga intervention just a decade ago, even by some yoga therapists. One example of this is schizophrenia. Although there is evidence of clinical yoga use for psychosis as early as 1972 (Auriol, 1972), the first published research of a small study on schizophrenia did not take place until 2003 (Naveen & Telles, 2003). Just 10 years later, there was a published meta-analysis evaluating five randomized controlled trials (RCTs) (Cramer, Lauche, Klose, Langhorst, & Dobos, 2013). In another example, research on yoga for posttraumatic stress disorder saw its first published trial in 2006 (van der Kolk, 2006). Since then there have been about a half-dozen trials published, with a number of trials currently ongoing (Wynn, 2015). Other examples of disorders for which there is a relatively recent appearance of published yoga therapy clinical trials include irritable bowel syndrome, stroke recovery, and restless legs syndrome. Surprisingly, despite the long history of prenatal yoga practice by the general public, and published articles advocating it in biomedically-oriented journals since the early 1980s (Weller, 1981), the first clinical trial of the efficacy of yoga for pregnancy was not published until 2005 (Narendran, Nagarathna, Narendran, Gunasheela, & Nagendra, 2005). Although there are now 10 published RCTs, 7 of these were published recently, between 2012 and 2014 (Jiang, Wu, Zhou, Dunlop, & Chen, 2015). Many other conditions currently being treated by yoga therapists also warrant clinical trials.

One area that may provide the greatest potential benefits to health care systems and society in general is yoga as preventive medicine. There has been a recent growth in the research on the health of long-term yoga practitioners compared with the general population, and these studies suggest that yoga practitioners are healthier than the general population and attribute their improved health to practicing yoga (Moliver, Mika, Chartrand, Haussmann, & Khalsa, 2013; Ross, Friedmann, Bevans, & Thomas, 2013). However, because these studies have been retrospective trials, they are subject to self-selection bias and other confounding factors. What are needed in this area are more prospective RCTs in the general population, especially long-term research studies of yoga for health maintenance, wellness, and disease prevention. There have been only a few short-term research trials published of yoga in work place settings, although the results are generally encouraging (Alexander, 2013; Hartfiel et al., 2012). Research on yoga in school settings is also a recent development (Serwacki & Cook-Cottone, 2012), growing in parallel with the increase of yoga intervention programs implemented in public and private school settings (Butzer, Ebert, Telles, & Khalsa, 2015; Hyde, 2012). Such studies have the potential for demonstrating that yoga may prevent noncommunicable lifestyle disease by providing behavioral skills that ameliorate the risk factors of chronic stress, mood impairment, and sedentary behavior. They will likely also show that yoga can enhance positive human behavior and psychological states, including increased well-being and mood, mind–body awareness, physical activity and self-efficacy, performance in work and school, and quality of life (Butzer, Bury, Telles, & Khalsa, 2016).

New outcome measures in yoga therapy research

A good deal of the most influential yoga therapy research in the recent past has come from the novel application of cutting-edge quantitative outcome measures, including brain imaging and molecular biology techniques, in addition to existing electrophysiological and biochemical assay approaches. There has been considerable literature on the evaluation of EEG and evoked potential changes during yoga and meditation practice, which has yielded general information on brain processes occurring during these practices. However, the challenges in interpreting results with respect to specific parts of the brain has somewhat limited the value of this research (Cahn & Polich, 2006). On the other hand, the development of miniature electrophysiological recording devices that can be worn for long periods, and other real-time assessments that can be done in a patient’s own environment, may provide important information about psychophysiological activity changes over time.

Brain imaging techniques (e.g., fMRI, MEG, SPECT) are superior to electrophysiological recordings in their capability of precisely localizing brain activity, allowing researchers to correlate brain activation with behavior. Brain imaging technology is also able to quantify changes in brain structure over time and even to evaluate neurochemical changes spectroscopically. Examples include yoga studies showing brain structure and activity changes related to pain tolerance and regulation (Villemure, Ceko, Cotton, & Bushnell, 2014), fluid intelligence (Gard et al., 2014), functional connectivity within basal ganglia cortico-thalamic feedback loops (Gard et al., 2015), and discrete neurotransmitters in specific brain regions (Streeter et al., 2010). This has produced a volume of research that is invaluable in demonstrating yoga-induced changes in brain functioning and the implications of such changes for behavior, disease, and therapy. It is likely that we are just at the beginning of a wave of brain imaging research on various contemplative practices (Newberg et al., 2014; Newberg, 2014).

Measurement of molecular biological outcome measures is another technological development likely to initiate a new wave of yoga research. This field includes evaluation of gene expression changes, or genomics, and associated changes in downstream events in transcripts (transcriptomics), proteins (proteomics), and metabolites (metabolomics), generally referred to collectively as “omics.” A landmark study by the Benson-Henry Institute for Mind Body Medicine demonstrated that contemplative practices, including yoga, induce significant changes in gene expression over both the short and long term (Dusek et al., 2008). Many of these epigenetic changes have related to physiological functions strongly associated with contemplative practices, for example, on stress, inflammation, and immune function (Bhasin et al., 2013). This approach has now been replicated by a number of laboratories (Black et al., 2013; Bower et al., 2014). Soon, researchers will likely be able to quantify changes in the expression of specific genes and downstream molecules in response to yoga practices and estimate how much these changes are involved in the efficacy of yoga in alleviating and preventing specific diseases.

Beyond the application of novel quantitative outcome measures in yoga therapy research, we are also seeing improvements in qualitative research. This includes more mixed-methods research (both qualitative and quantitative measures) incorporating first-person patient-based subjective outcomes (e.g., quality of life) and second-person assessments (collecting data from family and friends and about the patient) concomitantly with the more objective third-person assessments such as physical function, biological measures, and medical outcomes. Qualitative research combined with quantitative can help to give a more complete picture of patient experience. Qualitative research is especially valuable in the fields of mind–body medicine and contemplative practices research, where so little is known about the changes in psychological state and psychophysiology. Qualitative interviews can elucidate the first-hand experience of patients and practitioners and thereby suggest new psychological and behavioral constructs. These can then be further evaluated for their role in the therapeutic process through the development of new questionnaires and even psychophysiological measures. For example, there is evidence of a profound psychological transformation among long-time yoga practitioners, possibly driven by unitive peak experiences during deep meditative states. Such transformations may lead practitioners to voluntarily gravitate toward healthy behaviors, potentially facilitating long-term behavior change, which is so crucial in patients with lifestyle diseases. Qualitative research aimed at understanding and fostering such experiences might lead to quantitative and mechanistic research of this potentially important phenomenon (Caspi & Burleson, 2007). It is important to go beyond the narrow focus on the disease state and measure some of the outcomes that are emerging from the field of positive psychology. For example, measures of spirituality, purpose in life, compassion, and connection to others are all factors hypothesized to change when adopting a yogic way of life, and these changes could influence health states.

New experimental goals

Although research on the effects of yoga for managing and treating different chronic health conditions has proliferated in recent years, systematic research of yoga specifically as a therapeutic intervention is still relatively new, having started in the early 1970s (Cramer et al., 2014; Khalsa, 2004). Because of this, yoga therapy research studies to date have been mainly feasibility trials, single-arm pilot trials, and a small number of RCTs that have typically involved small sample sizes and comparisons to usual care. Most studies have examined one “dosage” of yoga and one kind of yoga program. These limitations restrict the conclusions that can be drawn from the results. For example, if studies simply compare yoga to usual care, then researchers cannot be certain that any differences can be directly attributed to yoga as opposed to those stemming from such nonspecific effects such as support, attention, and engaging in simple movements (Park et al., 2014).

Similarly, there is limited research examining whether specific yoga practices (or components of practice) are more or less useful than others for certain conditions. This type of research might help to demonstrate the relative effectiveness of different practices or components (e.g., inversions versus restorative poses to treat fatigue) and their specificity for treating different health conditions. However, because different yoga techniques may work together synergistically, and they can be combined in an almost infinite number of permutations, this type of dismantling research will have its limitations.

Future studies should consider the use of comparative effectiveness trials. In this way, there could be comparisons between different behavioral approaches to managing chronic diseases and even different yoga approaches, dosage, and clinical trial designs. Because many yoga RCTs have been small yet suggest favorable outcomes, the time is now right to move to larger, multicenter trials that focus on both efficacy (measured in ideal circumstances) and, importantly, effectiveness (measured in real-world settings). Yoga is a treatment modality for which there have been few adverse events, and as such it is positioned well to move to effectiveness trial designs (Cramer, Krucoff, & Dobos, 2013).

One of the biggest challenges in yoga research is the barrier of inducing participants assigned to practice yoga to participate in the group classes and/or home practices. This is true for all behavioral research as well as for simply trying to modify lifestyle factors in patients outside the research setting. Because data suggest that a greater frequency of practice is associated with better health outcomes, improved understanding of such barriers to practice becomes important. Other barriers might be the distance of the yoga studio from participants' work or home, the participants' physical limitations, or simple time constraints. Researchers will need to better assess the barriers and develop strategies to help patients engage in the practices assigned to them. Although it is in many ways ideal to have in-person sessions, one approach to encourage participation is to develop technologies for the remote delivery of yoga instruction. This approach has been successfully used for the delivery of exercise interventions (Demark-Wahnefried et al., 2012) and mind–body programs (Zernicke et al., 2014). However, there is also sparse information on the minimum amount of yoga practice required to achieve clinical benefit. Although a daily practice is usually best, even if it is only a brief one, this is not always realistic. Future research should directly address this question and test different levels of exposure both in and outside of class practice to determine the minimal practice time required to achieve clinical improvements. This applies not only to yoga as an intervention but also to all mind–body interventions, and this topic has been an important research question promoted by the National Center for Complementary and Integrative Health (NCCIH).

Finally, research has typically used a fixed, manualized yoga program for all participants. This is important to enable replication of studies, a hallmark of the scientific method. Although subtle modifications for individual needs are often allowed—to meet patient limitations and to avoid contraindications due to concomitant medical diagnoses, for example—all patients are taught the same basic yoga program. However, this approach by its nature does not allow the yoga practice to be specifically tailored to each participant and does not allow modifications in the program over time as the patient's condition evolves. These are elements that are central to a real-world yoga therapy practice, and this has been a criticism of existing yoga research by yoga therapists in the field. Conducting research using a more individualized approach will be challenging. If, however, the basis of individualization is clearly operationalized and documented, then study replication should be possible. Generally, yoga therapists maintain that using a more individualized approach, choosing practices that meet each patient's unique medical and life situation, will lead to more favorable outcomes than using the one-size-fits-all approaches in typical research protocols. This is an empirical question that should be tested, and this has also been recognized as an important research direction by NCCIH.

To date, however, funders of yoga research have been reluctant to support trials of individualized therapies. Therefore, a holistic, integrative approach to yoga therapy, in which treatments are based on a comprehensive assessment of the patient's imbalances (e.g., structural, breathing, ayurvedic, psychological), with treatments chosen specifically to address such imbalances, has, for all intents and purposes, never been studied. Instead, we have seen hundreds of studies of “cookbook” yoga routines assigned to participants based on the Western medical diagnosis (or focused on one of diagnoses in cases of comorbidity), which is not the way yoga therapy is practiced by most yoga therapists. Although standardized routines are much easier to study, they are a pale imitation of what good yoga therapists actually do and are likely to be inferior in efficacy to an integrative approach. There is also the concern that standardized yoga protocols will be “marketed” as the only ones shown to be effective in scientific studies, which may lead to such protocols becoming the standard of care rather than potentially more effective approaches to yoga therapy. Even more concerning is that if a particular standardized approach proves ineffective for a certain condition, yoga therapy as a whole may be dismissed as a therapeutic option, when the case may be that an individualized approach would have worked. To resolve these issues, head-to-head comparisons of standardized yoga protocols and individualized approaches are needed. Importantly, if it turns out that the latter are indeed more effective, it would suggest that past research has systematically underestimated the benefits of yoga therapy.

Other issues in research design

Research on the role of yoga in managing different chronic health conditions has typically adopted a conventional research approach. The gold standard remains the randomized, double-blind, placebo-controlled design. This standard is hard to meet when conducting behavioral-based research, and most studies using an RCT design have either compared yoga to usual care; a waitlist group; or, rarely, to some kind of active control (e.g., exercise) or attention control (e.g., educational support) (Park et al., 2014). Because many of the outcomes assessed are subjective in nature, being unblinded to group assignment and the intent of the study can lead to participant bias. However, there are strategies to decrease this bias (Wang et al., 2010). For example, when comparing yoga to an active control group such as exercise, participants can be informed that the purpose of the study is to compare different behavioral interventions intended to improve the condition or disease being studied. In this way, patients assigned to both the yoga and exercise groups believe they are getting the “real” treatment. This also makes it easier to keep some of the research staff blinded to group assignment. Although the truly double-blind design will be impossible or rare, given the lack of credible placebos to compare to the yoga intervention, this approach can at least decrease some of the inherent biases. A rare example is a study published in the journal *The Lancet* on bronchial asthma comparing active and passive lung exerciser devices in which the former device simulated a yogic pranayama technique (Singh, Wisniewski, Britton, & Tattersfield, 1990).

In the reporting of yoga research, investigators have often failed to provide sufficient information on the specifics of both the research design and its execution (Elwy et al., 2014). There has typically been a lack of detail in (1) describing the yoga intervention that was implemented, and (2) on the general level of training of the instructors and whether they had specific training or experience in working with the medical conditions or patient populations being treated. Providing such information is of the utmost importance both to enable study replication and also to enable translation of the research findings to the real world and provide the program to patients experiencing the medical condition investigated. Few studies have provided details on treatment fidelity monitoring, making it difficult to know if what was supposed to be taught to the patients was actually taught. The ideal approach to assessing treatment fidelity is to video-record all yoga therapy sessions and then have an unbiased, blinded expert monitor a random selection of recordings.

Future research should also examine factors that may modulate the effectiveness of yoga interventions. For example, what are the characteristics of individuals most likely to benefit from yoga? Are there certain individual characteristics that might help guide the specific yoga program? Equally important is to better understand the mediators of yoga, the mechanisms whereby yoga confers benefits at an individual level. In a disease such as depression, for example, mechanisms could be biological (e.g., reducing stress hormones, inflammation), neurological (e.g., decreasing beta waves and/or size of the amygdala), or psychosocial (e.g., increasing spiritual meaning or purpose in life). In researching the efficacy of yoga in treating specific medical conditions, the drivers of disease should be assessed in addition to disease outcomes.

Research challenges

Undoubtedly, the single greatest challenge the field of yoga research faces is its limited funding relative to conventional biomedical research. In the United States, the majority of yoga research has been supported by funding allotted to the NCCIH. The NCCIH budget is dwarfed by that of other conventional medicine-oriented NIH institutes, and yoga is only one of a large number of complementary approaches that compete for these limited funds. As private industry has become the main source of medical research funding, yoga will always be at a disadvantage, because there are no products to be patented and thus little possibility of industry-sponsored research. Funding for yoga as a disease prevention/health promotion model may be particularly problematic, because prevention research in general is vastly underfunded in modern health care systems.

Although much has been accomplished in recent years in the field of yoga research, there remains a negative bias among funders toward yoga research relative to more conventional behavioral interventions. This is often due to a lack of understanding of the nature of yoga and the intent of the practice. Despite the growth of the popularity of yoga and yoga therapy in the general public, and the rapid increase in the number of published, peer-reviewed yoga research studies, many biomedical researchers are under the mistaken impression that yoga is primarily a form of physical exercise practiced mostly by wealthy, white, middle-aged women as a hobby and therefore not worthy of consideration as a serious practice with any substantive therapeutic potential.

As the evidence mounts that multiple mind–body practices including yoga, Mindfulness-Based Stress Reduction, and tai chi can prevent and help to treat many chronic health conditions—and as the non-communicable lifestyle diseases extract an ever-greater toll on individuals, society, and health care systems—it is our hope that research funding will continue to expand. If this happens, and if the research increasingly documents the effectiveness of such behavioral approaches, we also hope that, ultimately, these practices will be incorporated within the standard of care in all outpatient and inpatient systems throughout the world.

Administrative issues

The field of yoga therapy is continuing to expand in many countries around the world—a burgeoning profession growing into its role in the future of health care. With the boom in the popularity of yoga in the West; an aging population seeking effective, integrative healing approaches; and an improving evidence base for the therapeutic effects of yoga, there is now an unprecedented and growing interest in therapeutic applications of yoga. As yoga therapy is more fully incorporated into health care systems, many people could be served who heretofore have had little access to yoga, particularly those of lower socioeconomic status and those geographically isolated in some inner city and rural areas. There has also been a resurgence of yoga in India in recent years and a concomitant growing interest in yoga therapy in health care settings there.

To date, however, yoga therapy has been largely an unregulated field. Anyone, regardless of training, has been able to claim qualification, certification, or experience as a yoga therapist. In most countries, no governmental agencies oversee yoga therapist accreditation or engage in any quality control strategies. There has been by and large no licensing, no credentialing, and no reimbursement from insurance companies. While this unregulated system has generally functioned well so far, it may not meet the needs of health care systems that want verifiable standards of training.

Accreditation and certification

Voluntary efforts have been taken within the yoga world to begin the accreditation of yoga therapy training programs and the certification of individual yoga therapists. As of this writing, the International Association of Yoga Therapists (IAYT; www.iayt.org) in the United States is implementing such programs. So far, more than a dozen training programs, all in the West, and predominantly in the United States, have been approved, two of which are master's level programs at accredited American universities. The IAYT is also setting up a procedure to certify individual yoga therapists. In India, the Council for Yoga Accreditation International (CYAI) represents many of India's top yoga and yoga therapy institutions as well as affiliated organizations in the West. The CYAI certifies graduates of affiliated programs upon completion of training and renews the certification of those who maintain proper continuing education credits. The CYAI also certifies physicians who specialize in yoga therapy (www.cyai.org).

It remains to be seen how well these certification systems will meet the needs of health care systems and how well they will be accepted by yoga teachers and yoga therapists. Some yoga therapists, working in the community rather than in health care systems, may opt out, preferring to continue with the methods that most yoga therapists to date have used to gain expertise, including self-study, informal apprenticeships with seasoned teachers in India and the West, and accumulating trainings from various teachers and traditions. Certification establishes a baseline for training, specifying, for example, the minimum number of hours in human anatomy and physiology or in yoga philosophy. Currently envisioned certification standards for yoga therapists include a minimum of 1,000 hours of training. But to master this complex, nuanced field may take many more hours than that, in addition to years of clinical experience.

Most yoga therapists believe that professionals in this field need to make an ongoing commitment to continually deepen in their studies and in their personal yoga practices.

Referrals

Given the newness of the field of yoga therapy, procedures for referral from health care providers are still being developed (see Chapter 22 for guidelines). To date, the process has mostly been informal. Referring clinicians may become aware of people presenting themselves as yoga therapists in their communities, and if they appear to be a good match, recommend them to their patients. In some medical practices, as well as in integrative practice teams in hospitals and clinics, yoga teachers and yoga therapists may be on staff. But in many locations there are not yet any (or a sufficient number of) qualified yoga therapists. However, with an increasing number of training programs, availability is likely to improve in coming years. Both the IAYT and the CYAI maintain searchable databases of yoga therapists on their websites.

Reimbursement

In most areas of the world, yoga therapists have functioned outside of any reimbursement systems from insurance companies or government programs. Some therapists who only accept private-pay clients offer sliding scale payments for less-well-off students and sometimes offer pro bono yoga therapy sessions or classes. In some countries, for example, in Europe, yoga teachers take part in national health programs and receive reimbursement for patients who take their classes. Some private health care plans in the United States subsidize general yoga classes or fitness club memberships, which include access to yoga classes. Medicare in the United States and some private insurers pay for the Ornish Program for Reversing Heart Disease, a comprehensive lifestyle intervention that includes yoga, for patients with heart disease. In addition, some yoga therapists have training in fields such as medicine, nursing, psychotherapy, physical therapy, and chiropractic, and may be able to obtain reimbursement for services that include yoga therapy.

Trends in treatment

One of the most significant trends in yoga therapy in the West in recent years is the growing incorporation of some elements of ayurveda, India's traditional holistic medical system (see Chapter 3) into the evaluation and treatment of patients. Because yoga and ayurveda both sprang from Indian soil, have existed side-by-side for thousands of years, and share the same foundation in classical Samkhya philosophy, yogis have been combining them for a long time.

As mentioned in Chapter 2 , yoga first came to America in 1893, when Swami Vivekananda addressed the World's

Parliament of Religions as part of the World's Columbian Exposition in Chicago. But it was not until around 1970 that ayurveda arrived in the United States, one fruit of the so-called counterculture's interest in Eastern philosophy and comprehensive healing approaches. Thus, for many decades yoga grew in the West largely independent of any (explicit) ayurvedic influence. However, popular books have been extolling the virtues of ayurveda for decades now. A growing number of ayurvedic practitioners and lifestyle consultants have been making their services available, and yoga practitioners have been among the most interested in this approach.

With the growth of integrative medicine has come a heightened interest among the Western population in many complementary health care modalities, including the use of herbal medicines, various kinds of therapeutic massage and bodywork techniques, acupuncture and other Asian medical systems such as ayurveda, and modalities such as qi gong and tai chi, any of which may be combined with yoga therapy. Barring contraindicated practices (see Chapter 22), there appear to be few untoward reactions from combining yoga with other health care modalities, both complementary and conventional—though this notion would benefit from further study. Of note, a large number of yoga teachers and yoga therapists in the West have trained in other health care modalities and are finding creative ways of integrating the practices.

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INDEX

In the main, Sanskrit terms have been prioritised throughout the index e.g. 'asanas' rather than 'postures' or 'poses', 'bhramari' rather than 'bee breath'. For specific asanas, again, the reader is referred to the Sanskrit name but will find cross-reference from the English name.

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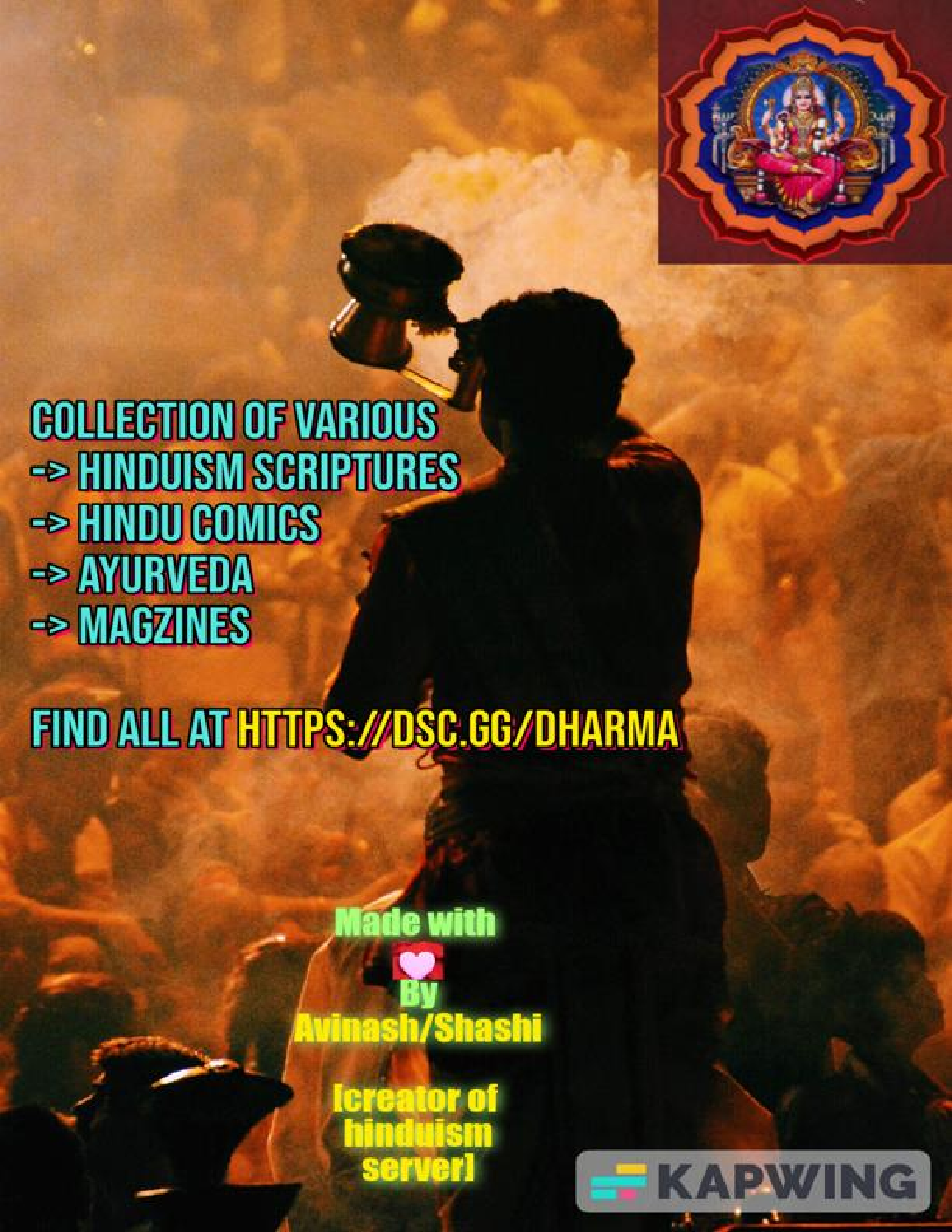
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