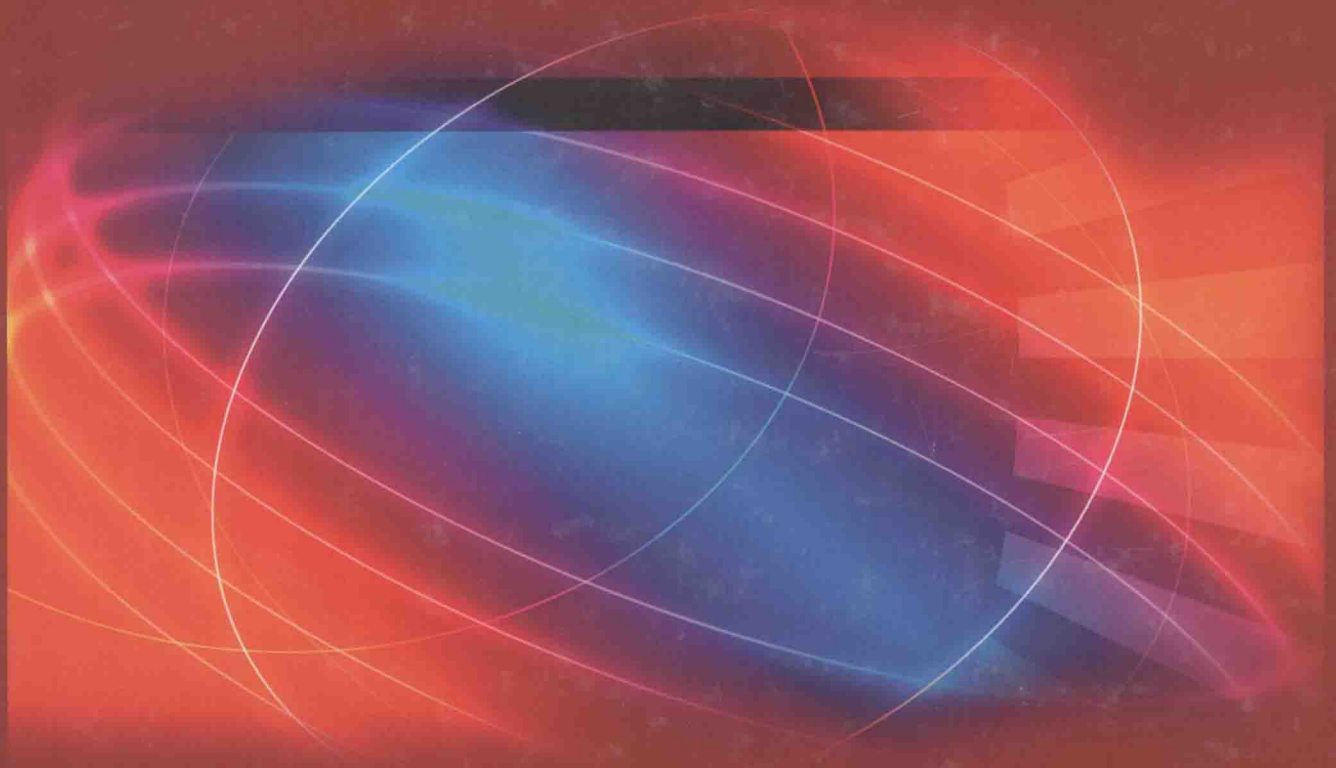


# CLINICAL EXERCISE PHYSIOLOGY

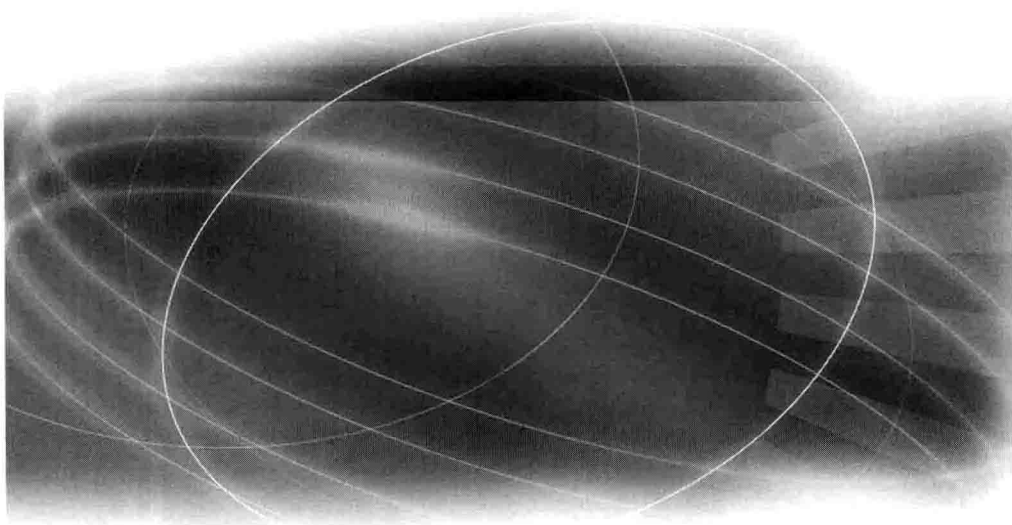
SECOND EDITION



Jonathan K. Ehrman • Paul M. Gordon  
Paul S. Visich • Steven J. Keteyian

# CLINICAL EXERCISE PHYSIOLOGY

SECOND EDITION



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# FOREWORD

The idea that exercise and physical activity improve health and well-being is well appreciated by public health officials, clinicians, and the public. What may be less well understood are its far-reaching benefits. Specifically, exercise not only aids in primordial prevention (preventing the development of disease-specific risk factors) but also promotes primary prevention (preventing the first occurrence of a disease-specific event) and secondary prevention (preventing the reoccurrence of a disease-related event). It is this latter form of prevention, secondary prevention, to which much of *Clinical Exercise Physiology* is devoted. Although we often appreciate the important role that exercise serves in the prevention and treatment of cardiovascular diseases, the favorable influence that it imparts across a broad spectrum of chronic diseases is made obvious in this book.

The foundational chapters in part I provide information on which subsequent chapters draw. The distinguished group of editors—Ehrman, Gordon, Keteyian, and Visich—and their expert contributors provide 27 additional population- or disease-specific chapters, each with up-to-date information regarding the role, methods, and expectations of how to assess, train, and prescribe exercise in patients with clinically manifest disease. Additionally, for both the student and the clinical exercise professional new to the field, *Clinical Exercise Physiology* provides a well-balanced, uniform, and evidence-based summary of the epidemiology, pathology, and treatment strategies associated with each disease.

No longer can we overlook the important role that exercise testing and training play in determining future risk and improving outcomes. Whether we care for patients with cancer, diabetes, cystic fibrosis, or arthritis, the symptoms or chief complaints of loss of physical function, the early onset of fatigue, and progressive exercise intolerance are common to essentially all patients who have a chronic disease. These concerns position exercise, with its long-standing history of improving fitness and

physical function, as a key adjunctive treatment able to improve not only exercise tolerance but in many instances quality of life and clinical outcomes as well.

Another important but potentially less recognizable contribution to come about from this second edition of *Clinical Exercise Physiology* is its role in further linking and advancing clinical exercise physiology as a profession. Following the standardization of the graduate curriculum for clinical exercise physiology in 2004, the creation in 2008 of a professional member association designated solely for clinical exercise physiologists (i.e., Clinical Exercise Physiology Association), and the ongoing offering of clinical certifications through the American College of Sports Medicine (ACSM), this book represents the definitive body of work and a repository of up-to-date and comprehensive clinical exercise information from which students and practitioners can draw. Clearly, with this second edition of *Clinical Exercise Physiology*, editors Ehrman, Gordon, Keteyian, and Visich have again done much to advance clinical exercise physiology as an allied health profession.

Whether you are studying in graduate school in preparation to enter the field, preparing to take an ACSM certification examination, or are now working in the field and desire to maintain your skills and learn new ones, you will likely find that this book meets your needs. And if you are like me, you will quickly come to appreciate the far-reaching and beneficial features and effects that exercise offers to a variety of patients who have a chronic disease or disability.

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# PREFACE

**Five years have passed since the first edition of *Clinical Exercise Physiology* was published, and much has occurred in both the field of practice and the science behind it. This text has quickly become the primary textbook for students preparing to become clinical exercise physiologists as well as an excellent resource for people preparing to sit for the American College of Sports Medicine Registered Clinical Exercise Physiologist (RCEP) examination. In 2003 clinical exercise physiology as a profession was just taking shape. Now it is blossoming into a profession that works within the healthcare system to deliver evidence-based care to a broad range of patients with chronic diseases. Although much important work remains, if two of the original purposes for this book were to disseminate the research associated with clinical exercise physiology and to provide a comprehensive resource for people working in the field, we are largely accomplishing what we set out to do.**

Continued evidence of the expanding role of clinical exercise physiology in healthcare includes the conduct of an increasing amount of clinical exercise physiology-related research and the incorporation of the results from such research into evidence-based guidelines for the treatment of patients with a variety of diseases. In 2008 a professional membership organization (the Clinical Exercise Physiology Association) was established to serve practitioners in the field through advocacy, the offering of continuing education, and membership networking. Additionally, organizations such as the American College of Sports Medicine (ACSM), the American Council on Exercise (ACE), and the American Society of Exercise Physiologists (ASEP) continue to offer several relevant certification and registry examinations, helping to provide uniformity to the level of preparedness of those working in the field or aspiring to do so. Finally, between the late 1960s and early 1980s, numerous undergraduate- and graduate-level exercise science or physiology curriculums were developed in U.S. universities. The subspecialty of clinical exercise physiology emerged over time from such programs, such that in 2004 clinical exercise physiology was formally recognized by the Commission on the Accreditation of Allied Health Education Programs (CAAHEP) as a field of study that required a formal and uniform graduate-level curriculum.

Although the day-to-day duties of people working today as clinical exercise physiologists mostly involve patients with cardiovascular disease, clinical exercise physiologists are now more than ever helping to care for patients with cancer, musculoskeletal disorders, and metabolic diseases such as chronic kidney disease and diabetes. Therefore, the timing is right for this revised version of what we believe has become a staple in the preparation of students interested in clinical exercise physiology. This second edition of *Clinical Exercise Physiology* is, we believe, better organized than its predecessor was. The initial part of the book presents five foundational chapters, including an excellent review of the history of clinical exercise physiology, a description of the essentials of the physical examination, and a comprehensive review of the pharmacology that confronts the practicing clinical exercise physiologist. Part II focuses on the general populations of children, the elderly, females, and those with depression. The remaining chapters, the core of the book, cover specific diseases and conditions. The chapters are organized into six parts, each relating to a physiology system: metabolic, cardiovascular, pulmonary, immunologic and hematologic, orthopedic and musculoskeletal, and neuromuscular.

Based on reviews and feedback from students and professors, we kept the general construction of the disease-related chapters in parts III through VIII of this second edition of *Clinical Exercise Physiology* the same. Each of the chapters in these sections begins with an introduction to the specific disease that includes the definition and scope of the disease and a discussion of the relevant pathophysiology. A focus on the medical and clinical considerations follows, including signs and symptoms, diagnosis, exercise testing, and evidence-based treatment. Each chapter concludes with an overview of the exercise prescription for the disorder being discussed, with special emphasis placed on any unique disease-specific issues that might alter the exercise prescription.

Each chapter also contains several practical application boxes that provide additional information summarizing unique chapter-specific information. In each of the disease-specific chapters two of these practical application boxes focus on the exercise prescription and on practical information to consider when interacting with the patient. A third practical application box reviews



the relevant exercise-training literature and discusses the physiological adaptations to exercise training and the ways that exercise can influence primary and secondary disease prevention. Finally, each chapter contains an actual patient case, progressing from initial presentation and diagnosis to therapy and exercise treatment. Each case study concludes with several questions aimed at facilitating group discussion in the classroom or for the individual learner to consider when preparing for the RCEP examination.

To keep abreast of trends in the field, four new chapters were added to cover metabolic syndrome, depression, stroke, and cerebral palsy. Additionally, each chapter has undergone a thorough revision to ensure that the material is consistent with current science and practice guidelines. The text also features a test package and presentation package for instructors—new to this edition and available online at [www.HumanKinetics.com/ClinicalExercisePhysiology](http://www.HumanKinetics.com/ClinicalExercisePhysiology).

- **Test package.** Created with Respondus 2.0, the test package includes approximately 457 true-or-false and multiple-choice questions. With Respondus, instructors can create versions of their own tests by selecting from the question pool; select their own test forms and save them for later editing or printing; and export the tests into a word-processing program.

- **Image bank.** Includes approximately 380 PowerPoint slides containing tables, illustrations, and photos from the text that instructors can use for class discussion

and illustration. The slides can be used directly within PowerPoint, or they can be printed to make transparencies or handouts for distribution to students. Instructors can easily add, modify, and rearrange the order of the slides. A blank PowerPoint template is also provided so instructors can create a personalized PowerPoint presentation.

Few, if any, graduate clinical exercise physiology programs in the United States currently provide students with the breadth of information required to sit for the ACSM RCEP examination. Those who plan to study to take this or any similar certification examination should understand that no single text provides in-depth coverage of all the clinical populations that benefit from physical activity and exercise. But this text may be as close as one can come. In all, *Clinical Exercise Physiology* addresses 27 different diseases and populations.

Besides serving as textbook for students studying in the field, *Clinical Exercise Physiology* is an excellent resource guide that the professional will want to have on her or his desk or office bookshelf. The features of consistent organization, case studies, discussion questions, up-to-date references, and feature boxes are designed to provide information required for effective study. In fact, the content was developed based on the KSAs (i.e., knowledge, skills, abilities) of the ACSM RCEP examination. We hope that this text serves as a valuable textbook for the student and as a useful desk reference for the practicing clinical exercise physiologist.

# ACKNOWLEDGMENTS

My sincere thanks for this second edition of *Clinical Exercise Physiology* go to the many contributors from both the first and second editions. Thanks for your time and talent in pulling this together. And thanks to Drs. Gordon, Keteyian, and Visich for their collaboration. Finally, my family always has my deep appreciation for putting up with me and supporting me in my professional and “play” endeavors. Janel, Joshua, Jacob, Jared, and Johanna, I love you all very much.

**Jonathan K. Ehrman**

As we continue to see the value of exercise with various chronic diseases, I am excited to see how this textbook has become accepted in our field. Only through the expertise of many contributors has this book been possible. I thank each of them. As a professor for the past 15 years I am excited that this comprehensive book in clinical exercise physiology can be offered to colleagues and, most important, to students in the field of exercise physiology who are interested in improving the health of others. I continue to thank my wonderful wife, Diane, who is always supportive of my endeavors; my two sons, Matt and Tim; and my parents, Frank and Mary, who have always encouraged their children to give their best effort in whatever they choose to do (success = drive + intelligence).

**Paul Visich**

Many thanks to everyone at Human Kinetics who helped us prepare and bring life to this second edition of a textbook that we again believe will do much to advance and support the rapidly expanding practice and profession of clinical exercise physiology. Thanks as well to my coeditors, contributing authors, and reviewers for the tireless efforts put forth on behalf of this book. My never-ending thanks to W. Douglas Weaver, MD, chief, division of cardiovascular medicine at Henry Ford Hospital, for his continued support of my effort to contribute to my chosen profession. As always, many blessings to Lynette, Stephanie, Courtland, Jacob, and Aram for their support of my professional interests. Finally, in loving memory of Albert Z. and Virginia Keteyian.

**Steven J. Keteyian**

The clinical exercise physiology specialty is now taking shape, and knowledge in the area is rapidly expanding. We are blessed to have a distinguished group of authors who have worked diligently to impart state-of-the-art knowledge about their respective subspecialties. Many thanks go to them for their tireless efforts as well as to the reviewers and staff who often go unnoticed behind the scenes to assure an exceptional final product.

To my wonderful wife, Ina, and my children, Joshua, Natalie, and Liam—thanks for putting up with me and providing much love, support, and understanding. Finally, in loving memory of my father, Edwin W. Gordon III, who always believed in me.

**Paul M. Gordon**

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