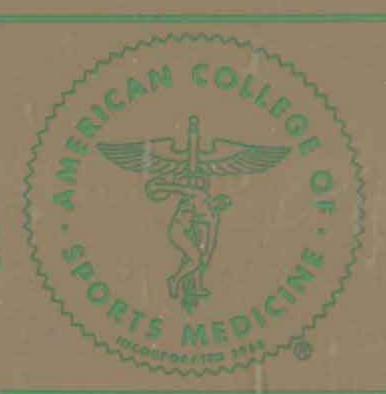
# AMERICAN COLLEGE OF SPORTS MEDICINE



# ACSMPs Guidelines for Exercise Testing and Prescription



Fifth Edition

# ACSM's GUIDELINES FOR EXERCISE TESTING AND PRESCRIPTION

5th Edition

### AMERICAN COLLEGE OF SPORTS MEDICINE



### Williams & Wilkins

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### PREFACE ...

The 5th edition of ACSM'S Guidelines for Exercise Testing and Prescription takes yet another major step in the evolution of this manual first published by the American College of Sports Medicine (ACSM) in 1975. As in previous editions of the Guidelines, the continued aim of this revision is to present state-of-the-art information in a usable form for both the fitness and clinical exercise professional. Several major changes have been incorporated into this edition, however, which reflect the growing body of knowledge in this area as well as the growing reference needs of the men and women comprising this expanding and diversifying profession. It is hoped that these additions and modifications will expand the utility of this book, bringing it off the office shelf and into the lab coat pocket or onto the desktop in the exercise testing or leadership arena.

One intent of the authors of this revision was to limit the book's focus to exercise testing in its broadest sense and exercise prescription in all of its forms. Toward that goal, some chapters were deleted from the fourth edition (e.g., "Clinical Exercise Physiology"), because these topics are now covered more comprehensively in other ACSM publications. Thus, the 5th edition of the *Guidelines* presents a more narrowed and concise focus on exercise testing and exercise prescription.

At the time of publication of the early editions of the Guidelines, companion and complementary publications by ACSM did not exist. There are now several ACSM publications in print or in preparation which complement and expand upon this book. The unique role of the

### VI PREFACE

5th edition of the Guidelines is to present easily accessible information relevant to exercise testing and prescription. For more detailed treatment of topics covered in the Guidelines, the reader is directed to its companion publication, the Resource Manual for the Guidelines for Exercise Testing and Prescription (2nd ed.). Where minor inconsistencies exist between the Guidelines and the Resource Manual, the reader is reminded that this is due to differing publication cycles for these two books, and that the former drives the latter. For special populations not covered in the Guidelines, the reader is referred to Exercise Management for Persons with Chronic Diseases and Disabilities, to be published in 1996. Finally, the ACSM Fitness Book provides fitness information and an easy-to-use fitness program designed for use by the apparently healthy adult who wishes to start an exercise program.

A decision was made to include more quantitative data—threshold values, clinical laboratory cutoffs considered "abnormal," normative fitness data—than were included in previous editions. Where appropriate, those values are referenced to reports or publications prepared by other professional organizations. It is not the policy of ACSM to endorse criteria established by one organization over another, but to provide scientifically based, clinically sound guidelines which, in combination with professional judgment, can be used by the exercise professional in decision making.

Also in terms of content, the 5th edition provides expanded information aimed at fitness professionals whose clientele fit into the category of the "apparently healthy adult." Such information is included under the headings of both Exercise Testing (Physical Fitness Testing) and Exercise Prescription. Three healthy "special populations" are covered in greater detail, namely chil-

dren, pregnant women, and the elderly (Chapter 11). Another area of expanded coverage is testing and prescription for pulmonary patients. Finally, several appendices were added, including a brief ECG interpretation schemata with standard values (Appendix C) and expanded treatment of environmental considerations (Appendix E). Appendix D (Metabolic Calculations) has been completely rewritten to improve its clarity, and Appendix F now presents information about ACSM Certification Programs, including revised knowledge, skills, and abilities (formerly called Behavioral Objectives and Specific Learning Objectives) underlying each level of certification.

Finally, the most obvious change to the longtime user of the *Guidelines* is the presentation style and format of the book. These changes were made in an effort to increase the utility of the book for the working exercise professional.

This edition has been prepared by a volunteer writing team with representative expertise in physiology, fitness, cardiology, pulmonary medicine, nursing, and physical therapy. It has undergone extensive review by many members of the American College of Sports Medicine. The College and the writing team wish to express their thanks to all those who have contributed ideas, comments, written material, and editorial assistance.

W. Larry Kenney, Ph.D., FACSM Senior Editor

### NOTE BENE

The views and information contained in the 5th edition of ACSM'S Guidelines for Exercise Testing and Prescription vided as guidelines as opposed to standards of practice. This distinction is an important one, since specific legal connotations may be attached to such terminology. The distinction is also critical inasmuch as it gives the exercise professional the freedom to deviate from these guidelines when necessary and appropriate in the course of exercising independent and prudent judgment. ACSM'S Guidelines for Exercise Testing and Prescription presents a framework which the professional may certainly—and in some cases has the obligation to—tailor to individual client or patient needs and alter to meet institutional or legislated requirements.

### LIST OF ABBREVIATIONS

**AACVPR** American Association of Cardiovascular and

Pulmonary Rehabilitation

ACE angiotensin converting enzyme

ACGIH American Conference of Governmental

Industrial Hygienists

ACOG American College of Obstetricians and

Gynecologists

ACP American College of Physicians

ACSM American College of Sports Medicine

**ADL** activities of daily living

AHA American Heart Association

AIHA American Industrial Hygiene Association

AMA American Medical Association

**AMS** acute mountain sickness

**AICD** automatic implantable cardioverter defibrillator

**AST** aspartate aminotransferase

AV atrioventricular

**BIA** bioelectrical impedance analysis

BLS basic life support
BMI body mass index
BP blood pressure
BR breathing reserve
BUN blood urea nitrogen

ceiling (heat stress) limit

CABG(S) coronary artery bypass graft (surgery)

CAD coronary artery disease CHF congestive heart failure

CHO carbohydrate CI cardiac index

COPD chronic obstructive pulmonary disease continuous positive airway pressure

CPR cardiopulmonary resuscitation

**CPK** creatine phosphokinase

### X LIST OF ABBREVIATIONS

DBP diastolic blood pressure

**DOMS** delayed onset muscle soreness

ECG electrocardiogram ejection fraction

**EIB** exercise-induced bronchoconstriction

**EIH** exercise-induced hypotension

**EL** Exercise Leader<sub>SM</sub>

**ERV** expiratory reserve volume

ES Exercise Specialist<sub>SM</sub>

ETT Exercise Test Technologist<sub>SM</sub>

FC functional capacity

**FEV**<sub>1.0</sub> forced expiratory volume in one second

F<sub>1</sub>O<sub>2</sub> fraction of inspired oxygen

F<sub>1</sub>CO<sub>2</sub> fraction of inspired carbon dioxide

FN false negativeFP false positive

FRV functional residual volume

**FVC** forced vital capacity graded exercise test

HAPE high altitude pulmonary edema

HDL high density lipoprotein
HFD Health/Fitness Director®

HFI Health/Fitness Instructor<sub>SM</sub>

**HR** heart rate

HR<sub>max</sub> maximal heart rate
HR<sub>rest</sub> resting heart rate
inspiratory capacity

IDDM insulin-dependent diabetes mellitus

KSAs knowledge, skills, and abilities

LAD left axis deviation

LBBB left bundle branch block
LDH lactate dehydrogenase
LDL low density lipoprotein
L-G-L Lown-Ganong-Levine

**LLN** lower limit of normal

LV left ventricle (left ventricular)

MCHC mean corpuscular hemoglobin concentration

MET metabolic equivalent myocardial infarction

MVC maximal voluntary contraction

MVV maximal voluntary ventilation

NCEP National Cholesterol Education Program noninsulin-dependent diabetes mellitus

NIH National Institutes of Health

NIOSH National Institute for Occupational Safety and

Health

NYHA New York Heart Association

Pao<sub>2</sub> partial pressure of arterial oxygen

PAC premature atrial contraction

PAR-Q Physical Activity Readiness Questionnaire

PD Program Director<sub>SM</sub>

PE<sub>max</sub> maximal expiratory pressure PI<sub>max</sub> maximal inspiratory pressure

PNF proprioceptive neuromuscular facilitation

Po<sub>2</sub> partial pressure of oxygen (ambient)
PTCA percutaneous transluminal coronary

angioplasty

PVC premature ventricular contraction

PVD peripheral vascular disease respiratory exchange ratio

RAD right axis deviation

RAL recommended alert limit right bundle branch block

rep repetition

**RIMT** resistive inspiratory muscle training

1-RM one repetition maximum

RQ respiratory quotient

### XII LIST OF ABBREVIATIONS

RPE rating of perceived exertion

RV residual volume

RVG radionuclide ventriculography
right ventricular hypertrophy

S<sub>a</sub>O<sub>2</sub> % saturation of arterial oxygen

SBP systolic blood pressure

SPECT single photon emission computerized

tomography

SVT supraventricular tachycardia

TLC total lung capacity

TN true negative true positive

TPR total peripheral resistance

TV tidal volume VC vital capacity

Vco<sub>2</sub> volume of carbon dioxide per minute

v<sub>E</sub> expired ventilation per minute
 v<sub>I</sub> inspired ventilation per minute

volume of oxygen consumed per minute

Vo<sub>2max</sub> maximal oxygen uptake

Vo<sub>2peak</sub> peak oxygen uptake VT ventilatory threshold

**WBGT** wet-bulb globe temperature

WHR waist-to-hip ratio

W-P-W Wolffe-Parkinson-White

YMCA Young Men's Christian Association
YWCA Young Women's Christian Association

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