### Contents

Dedication ................................................................. v
In Memoriam .............................................................. vii
Series Editor Introduction ............................................ ix
Preface ................................................................. xiii
Contributors ........................................................... xx

**PART I: INTRODUCTION AND BASIC BIOLOGY**

1 Vitamin D and Health: Evolution, Biologic Functions, and Recommended Dietary Intakes for Vitamin D ................ 3
   Michael F. Holick

2 Photobiology of Vitamin D ......................................... 35
   Tai C. Chen, Zhiren Lu, and Michael F. Holick

3 The Functional Metabolism and Molecular Biology of Vitamin D Action .......................... 61
   Lori A. Plum and Hector F. DeLuca

4 Metabolism and Catabolism of Vitamin D, Its Metabolites and Clinically Relevant Analogs .................. 99
   Glenville Jones

5 The Molecular Biology of the Vitamin D Receptor .................................................. 135
   Diane R. Dowd and Paul N. MacDonald

6 VDR and RXR Subcellular Trafficking .............................................. 153
   Julia Barsony

7 Mechanism of Action of 1,25-Dihydroxyvitamin D₃ on Intestinal Calcium Absorption and Renal Calcium Transport .................... 175
   Dare Ajibade, Bryan S. Benn, and Sylvia Christakos

8 Biological and Molecular Effects of Vitamin D on Bone ........................................ 189
   Martin A. Montecino, Jane B. Lian, Janet L. Stein, Gary S. Stein, André J. van Wijnen, and Fernando Cruzat

9 Biological and Molecular Effects of Vitamin D on the Kidney .................................. 211
   Adriana S. Dusso and Masanori Tokumoto
10 Vitamin D and the Parathyroids ........................................ 235
Justin Silver and Tally Naveh-Many

11 Diversity of Vitamin D Target Genes ................................. 255
Carsten Carlberg

PART II: NON-SKELETAL/ FUNCTIONS OF VITAMIN D

12 Extrarenal Synthesis of 1,25-Dihydroxyvitamin D and Its Health Implications ........................... 277
Daniel D. Bikle

13 Vitamin D and the Innate Immunity ................................ 297
Philip T. Liu, Martin Hewison, and John S. Adams

14 Vitamin D and Colon Cancer ........................................... 311
Heide S. Cross and Meinrad Peterlik

15 Mechanisms of Resistance to Vitamin D Action in Human Cancer Cells ............................. 325
María Jesús Larriba and Alberto Muñoz

16 Vitamin D and the Brain: A Neuropsychiatric Perspective .......................... 335
Louise Harvey, Thomas Burne, Xiaoying Cui, Alan Mackay-Sim,
Darryl Eyles, and John McGrath

17 Vitamin D Modulation of Adipocyte Function ........................ 345
Michael B. Zemel and Xiaocun Sun

PART III: VITAMIN D STATUS – GLOBAL ANALYSIS

18 Determinants of Vitamin D Intake ...................................... 361
Mona S. Calvo and Susan J. Whiting

19 25-Hydroxyvitamin D Assays and Their Clinical Utility .................. 383
N. Binkley and G. Lensmeyer

20 Health Disparities and Vitamin D ......................................... 401
Douglass Bibuld

21 Vitamin D Deficiency in Canada ........................................ 425
David A. Hanley

22 Vitamin D Deficiency and Its Health Consequences in Northern Europe ......................... 435
Leif Mosekilde

23 Vitamin D Deficiency and Consequences for the Health of People in Mediterranean Countries ........................................... 453
Jose Manuel Quesada-Gomez and Manuel Díaz-Curiel

24 Vitamin D Deficiency in the Middle East and Its Health Consequences .................. 469
Ghada El-Hajj Fuleihan

25 Vitamin D Deficiency in the Middle East and Its Health Consequences for Adults .................. 495
Samer El-Kaissi and Suphia Sherbeeni
Vitamin D Deficiency and Its Health Consequences in Africa ........... 505
   Ann Prentice, Inez Schoenmakers, Kerry S. Jones,
   Landing M.A. Jarjou, and Gail R. Goldberg

Vitamin D Deficiency and Its Health Consequences in India ........... 529
   R.K. Marwaha and R. Goswami

Vitamin D Deficiency, Rickets, and Fluorosis in India ................. 543
   C. V. Harinarayan and Shashank R. Joshi

Vitamin D in Asia ........................................ 563
   Tim Green and Bernard Venn

Vitamin D Deficiency and Its Health Consequences in New Zealand ... 589
   Mark J. Bolland and Ian R. Reid

Toxicity of Vitamin D ....................................... 603
   Reinhold Vieth

PART IV: HEALTH CONSEQUENCES OF VITAMIN D
          DEFICIENCY AND RESISTANCE ON
          MUSCULOSKELETAL HEALTH

Vitamin D Deficiency in Pregnancy and Lactation and Health Consequences . . 615
   Sarah N. Taylor, Carol L. Wagner, and Bruce W. Hollis

Vitamin D Deficiency in Children and Its Health Consequences ........... 633
   Amy D. DiVasta, Kristen K. van der Veen,
   and Catherine M. Gordon

Dietary Calcium Deficiency and Rickets ............................ 651
   John M. Pettifor, Philip R. Fischer, and Tom D. Thacher

Vitamin D in Fracture Prevention and Muscle Function and Fall Prevention . . 669
   Heike Bischoff-Ferrari

Inherited Defects of Vitamin D Metabolism .......................... 679
   Marie B. Demay

Molecular Defects in the Vitamin D Receptor Associated
   with Hereditary 1,25-Dihydroxyvitamin D-Resistant Rickets (HVDRR) .... 691
   Peter J. Malloy and David Feldman

Receptor-Independent Vitamin D Resistance in Subhuman
   and Human Primates ........................................... 715
   John S. Adams, Hong Chen, Thomas S. Lisse, Rene F. Chun,
   and Martin Hewison

25-Hydroxyvitamin D-1α-Hydroxylase: Studies in Mouse Models
   and Implications for Human Disease ............................ 729
   David Goltzman
PART V: SUNLIGHT, VITAMIN D AND CANCER

40 The Health Benefits of Solar Irradiance and Vitamin D and the Consequences of Their Deprivation ........................................ 745
    William B. Grant

41 Vitamin D Status, Solar Radiation and Cancer Prognosis .................. 765
    Johan Moan, Øyvind Sverre Bruland, Arne Dahlback,
    Asta Juzeniene, and Alina Carmen Porojnicu

42 The Epidemiology of Vitamin D and Cancer Risk .......................... 777
    Edward Giovannucci

43 Vitamin D Deficiency and the Epidemiology of Prostate Cancer .......... 797
    Gary G. Schwartz

44 Vitamin D for Cancer Prevention and Survival ............................ 813
    Edward D. Gorham, Sharif B. Mohr,
    Frank C. Garland, and Cedric F. Garland

45 The Anti-cancer Effect of Vitamin D: What Do the Randomized Trials Show? 841
    Joan M. Lappe and Robert P. Heaney

46 Sunlight, Skin Cancer, and Vitamin D ................................... 851
    Jörg Reichrath

PART VI: VITAMIN D DEFICIENCY AND CHRONIC DISEASE

47 Vitamin D and the Risk of Type 1 Diabetes .............................. 867
    Elina Hyppönen

48 Vitamin D and Multiple Sclerosis ........................................ 881
    Alberto Ascherio and Kassandra L. Munger

49 Vitamin D and Type 2 Diabetes .......................................... 895
    Myrto Eliades and Anastassios G. Pittas

50 Role of Vitamin D for Cardiovascular Health ............................ 921
    Robert Scragg

51 Vitamin D, Renin, and Blood Pressure .................................. 937
    Yan Chun Li

52 Role of Vitamin D and Vitamin D Analogs for Bone Health and Survival in Chronic Kidney Disease ................................. 955
    Ishir Bhan, Hector Tamez, and Ravi Thadhani

53 Role of Vitamin D and Ultraviolet Radiation in Chronic Kidney Disease 967
    Rolfdieter Krause

54 Role of Vitamin D in Rheumatoid Arthritis ................................ 985
    Linda A. Merlino

55 Vitamin D, Respiratory Infections, and Obstructive Airway Diseases ........ 997
    Carlos A. Camargo Jr, Adit A. Ginde, and Jonathan M. Mansbach
PART VII: CLINICAL USES OF VITAMIN D ANALOGUES

56  Treatment of Immunomediated Diseases by Vitamin D Analogs .......................... 1025
    Luciano Adorini

57  Clinical Utility of 1,25-Dihydroxyvitamin D₃ and Its Analogues
    for the Treatment of Psoriasis ........................................... 1043
    Jörg Reichrath and Michael F. Holick

58  Affinity Alkylating Vitamin D Analogs as Molecular Probes
    and Therapeutic Agents .................................................. 1061
    Rahul Ray

59  Anti-inflammatory Activity of Calcitriol That Contributes
    to Its Therapeutic and Chemopreventive Effects in Prostate Cancer ............... 1087
    Aruna V. Krishnan and David Feldman

Subject Index .......................................................... 1105