Preface, xii
Acknowledgements, xiii
About the companion website, xvi
Abbreviations, xvii
Glossary of terms used in this book, xviii

1 Introduction to lifespan nutrition, 1
1.1 The lifespan approach to nutrition, 1
1.2 The concept of balance, 2
1.2.1 A supply and demand model, 2
1.2.2 Overnutrition, 2
1.2.3 Undernutrition, 4
1.2.3.1 Increased demand, 4
1.2.3.2 The metabolic response to trauma, 4
1.2.3.3 Compromised supply and deficiency, 6
1.2.3.4 Malnutrition, 6
1.2.4 Classical balance studies, 8
1.2.5 Overall nutritional status, 9
1.3 The individual response to nutrition, 10
1.3.1 Stage of the lifespan, 10
1.3.2 Genetics, 12
1.4 Assessment of nutritional status, 13
1.4.1 Anthropometric measures, 14
1.4.2 Estimating dietary intakes, 14
1.4.2.1 Indirect measures, 14
1.4.2.2 Direct measures, 16
1.4.2.2.1 Dietary recall methods, 16
1.4.2.2.2 Food record methods, 17
1.4.2.2.3 Food frequency questionnaire methods, 17
1.4.3 Biomarkers of nutritional status, 18
1.4.4 Clinical examination, 20
1.5 Nutritional epidemiology: Understanding diet–disease relationships, 20
1.5.1 Cause and effect, 20
1.5.2 Bias and confounding, 21
1.5.3 Quantifying the relationship between diet and disease, 22
1.5.4 Study designs in nutritional epidemiology, 24
1.5.4.1 Ecological studies, 25
1.5.4.2 Cross-sectional studies, 25
1.5.4.3 Case–control studies, 26
1.5.4.4 Cohort studies, 26
1.5.4.5 RCTs, 26
1.5.4.6 Systematic review and meta-analysis, 27
1.6 Dietary reference values, 28
1.6.1 The UK DRV system, 28
1.6.2 DRVs in other countries, 31

2 Before life begins, 35
2.1 Introduction, 35
2.2 Nutrition and female fertility, 36
2.2.1 Determinants of fertility and infertility, 36
2.2.1.1 The endocrine control of female reproduction, 36
2.2.1.2 Disordered reproductive cycling, 37
2.2.1.3 PCOS, 38
2.2.2 Importance of body fat, 39
2.2.3 Role of leptin, 39
2.2.4 Antioxidant nutrients, 41
2.2.5 Caffeine and alcohol, 43
2.3 Nutrition and male fertility, 44
2.3.1 Determinants of fertility and infertility, 44
2.3.2 Obesity, 46
2.3.3 Alcohol, 47
2.3.4 Zinc, 48
2.3.5 Antioxidant nutrients, 48
2.3.6 Selenium, 49
2.3.7 Phytoestrogens and environmental oestrogens, 49
2.3.7.1 Phthalates, 50
2.3.7.2 Phytoestrogens, 50
2.3.7.3 Pesticides, 51
2.4 Preparation for pregnancy, 52
2.4.1 Why prepare for pregnancy?, 52
2.4.2 Maternal weight management, 52
2.4.3 Vitamin A and liver, 52
2.4.4 Folic acid and neural tube defects, 54
2.4.4.1 Supplementation with folic acid, 55
2.4.4.2 Fortification with folic acid, 55
# 3 Pregnancy, 61

3.1 Introduction, 61  
3.2 Physiological demands of pregnancy, 62  
3.2.1 Maternal weight gain and body composition changes, 63  
3.2.2 Blood volume expansion and cardiovascular changes, 63  
3.2.3 Renal changes, 64  
3.2.4 Respiratory changes, 64  
3.2.5 Gastrointestinal changes, 65  
3.2.6 Metabolic adaptations, 65  
3.3 Nutrient requirements in pregnancy, 66  
3.3.1 Energy, protein and lipids, 66  
3.3.2 Micronutrients, 68  
3.3.2.1 Iron, 68  
3.3.2.2 Calcium and other minerals, 69  
3.3.2.3 Vitamin D, 70  
3.4 Diet in relation to pregnancy outcomes, 71  
3.4.1 Miscarriage and stillbirth, 71  
3.4.2 Premature labour, 72  
3.4.2.1 Pre-pregnancy BMI and pregnancy weight gain, 72  
3.4.2.2 Alcohol and caffeine consumption, 73  
3.4.2.3 Oral health, 74  
3.4.3 Hypertensive disorders of pregnancy, 76  
3.4.3.1 The aetiology of PE, 77  
3.4.3.2 Nutrition-related factors and PE, 77  
3.4.4 Abnormal labour, 79  
3.5 Nausea and vomiting of pregnancy, 79  
3.5.1 Nausea and vomiting of pregnancy as a normal physiological process, 79  
3.5.2 Hyperemesis gravidarum, 81  
3.6 Cravings and aversions, 82  
3.6.1 Pica, 83  
3.7 Gastrointestinal disturbances in pregnancy, 84  
3.8 High-risk pregnancies, 84  
3.8.1 Gestational diabetes, 84  
3.8.2 Multiple pregnancies, 86  
3.8.3 Foetal alcohol spectrum disorders, 87  

# 4 Fetal nutrition and disease in later life, 94

4.1 Introduction, 94  
4.2 The developmental origins of adult disease, 94  
4.2.1 The concept of programming, 94  
4.2.2 Fetal programming and human disease, 95  
4.2.2.1 Fetal growth, 95  
4.2.2.2 Nutrition and the constraint of growth, 96  
4.2.2.3 Fetal growth, health and disease, 97  
4.3 Evidence linking maternal nutrition to disease in later life, 99  
4.3.1 Epidemiology, 99  
4.3.2 Criticisms of the programming hypothesis, 102  
4.3.3 Experimental studies, 103  
4.3.3.1 Global undernutrition, 104  
4.3.3.2 Micronutrients, 104  
4.3.3.3 Macronutrients, 105  
4.4 Mechanistic basis of fetal programming, 106  
4.4.1 Thrifty phenotypes and genotypes, 106  
4.4.2 Mismatched environments, 108  
4.4.3 Tissue remodelling, 108  
4.4.4 Endocrine imbalance, 109  
4.4.5 Nutrient–gene interactions, 111  
4.4.5.1 Polymorphisms in humans, 111  
4.4.5.2 Gene expression in animals, 112  
4.4.6 Epigenetic regulation, 113  
4.5 Implications of the programming hypothesis, 115  
4.5.1 Public health interventions, 115  
4.5.2 Trans-generational transmission of disease risk, 117  

# 5 Lactation and infant feeding, 123

5.1 Introduction, 123  
5.2 The physiology of lactation, 123  
5.2.1 Anatomy of the breast, 123  
5.2.1.1 The nipple and areola, 123  
5.2.1.2 The lactiferous ducts, 124  
5.2.1.3 The lactiferous sinuses, 124  
5.2.1.4 The alveolar cells, 124  
5.2.1.5 The rooting reflex, 124  
5.2.2 Synthesis of milk, 124  
5.2.2.1 Foremilk and hindmilk, 125  
5.2.2.2 Time of day, 125  
5.2.2.3 Course of lactation, 125  
5.2.2.4 Synthesis of carbohydrates, 125  
5.2.2.5 Origins of milk fats, 126  
5.2.2.6 Milk proteins, 126  
5.2.3 Endocrine control of lactation, 127  
5.2.3.1 The breast during pregnancy, 127  
5.2.3.2 Established lactation, 128  
5.2.3.3 The breast after weaning, 128  
5.2.4 Maintenance of lactation, 129  
5.2.5 Nutritional demands of lactation, 129  
5.3 The advantages of breastfeeding, 130  
5.3.1 Advantages for the mother, 130  
5.3.2 Advantages for the infant, 132  
5.3.3 Recommendation to feed to 6 months, 135  
5.4 Trends in breastfeeding behaviour, 136  
5.4.1 Reasons why women do not breastfeed, 138  
5.4.2 Promoting breastfeeding, 140
5.5 Situations in which breastfeeding is not advised, 141
5.6 Alternatives to breastfeeding, 143
  5.6.1 Cow’s milk formulas, 143
  5.6.1.1 Milk stages and follow-on milk, 144
  5.6.2 Preterm formulas, 145
  5.6.3 Soy formulas, 146
  5.6.4 Hydrolysed protein and amino acid-based formulas, 146
  5.6.5 Other formulas, 146

6 Nutrition and childhood, 150
  6.1 Introduction, 150
  6.2 Infancy (birth to five), 150
    6.2.1 The key developmental milestones, 150
    6.2.2 Nutrient requirements, 151
      6.2.2.1 Macronutrients and energy, 152
      6.2.2.2 Micronutrients, 154
    6.2.3 Nutrient intakes and infants, 154
    6.2.4 Transition to an adult pattern of food intake, 156
      6.2.4.1 Complementary feeding, 156
      6.2.4.2 Nutrition-related problems, 159
        6.2.4.2.1 Zinc deficiency, 160
        6.2.4.2.2 Vitamin D deficiency, 160
        6.2.4.2.3 Iron deficiency, 161
        6.2.4.2.4 Food additives and hyperactivity, 161
      6.2.4.3 Barriers to healthy nutrition, 162
        6.2.4.3.1 Faddy eating, 162
        6.2.4.3.2 Poverty, 163
        6.2.4.3.3 The impact of advertising, 165
        6.2.4.3.4 Restrictive dietary practices, 167
  6.3 Childhood (5–13), 167
    6.3.1 Nutrient requirements of the older child, 167
    6.3.2 School meals and the promotion of healthy eating, 168
    6.3.3 The importance of breakfast, 169
  6.4 Obesity in children, 170
    6.4.1 The rising prevalence of obesity, 170
    6.4.2 The causes of obesity in childhood, 171
      6.4.2.1 Physical activity, 172
      6.4.2.2 Food intake, 173
      6.4.2.3 Genetic disorders, 175
    6.4.3 The consequences of childhood obesity, 176
      6.4.3.1 Immediate health consequences, 176
      6.4.3.2 Tracking of obesity: Consequences for the future, 176
    6.4.4 Treatment of childhood obesity, 178
    6.4.5 Prevention of childhood obesity, 180

7 Nutrition and adolescence, 189
  7.1 Introduction, 189
  7.2 Physical development, 189
    7.2.1 Growth rate, 189
    7.2.2 Body composition, 190
    7.2.3 Puberty and sexual maturation, 191
    7.2.4 Bone growth, 193
  7.3 Psychosocial development, 196
  7.4 Nutritional requirements in adolescence, 197
    7.4.1 Macronutrients and energy, 197
    7.4.2 Micronutrients, 198
  7.5 Nutritional intakes in adolescence, 199
    7.5.1 Factors that influence food choice, 200
    7.5.2 Food consumed out of the home, 201
    7.5.3 Meal skipping and snacking, 202
  7.6 Potential problems with nutrition, 203
    7.6.1 Dieting and weight control, 203
    7.6.2 The vegetarian teenager, 204
    7.6.3 Sport and physical activity, 204
    7.6.4 Eating disorders, 206
      7.6.4.1 AN, 206
      7.6.4.2 BN, 208
    7.6.5 The pregnant teenager, 209
    7.6.6 Alcohol, 210
    7.6.7 Tobacco smoking, 212
    7.6.8 Drug abuse, 213

8 The adult years, 219
  8.1 Introduction, 219
  8.2 Changing needs for nutrients, 219
  8.3 Guidelines for healthy nutrition, 220
  8.4 Disease states associated with unhealthy nutrition and lifestyle, 223
    8.4.1 Obesity, 223
      8.4.1.1 Classification of overweight and obesity, 223
      8.4.1.2 Prevalence and trends in obesity, 223
      8.4.1.3 Causes of obesity in adulthood, 224
      8.4.1.4 Treatment of obesity, 224
    8.4.2 Type 2 diabetes, 226
    8.4.3 The metabolic syndrome, 229
    8.4.4 Cardiovascular disease, 230
      8.4.4.1 What is CVD?, 230
        8.4.4.1.1 Atherosclerosis, 230
        8.4.4.1.2 CHD, 232
        8.4.4.1.3 Cerebrovascular disease, 232
        8.4.4.1.4 Peripheral artery disease, 232
        8.4.4.1.5 Hypertension, 232
8.4.4.2 Risk factors for CVD, 233
8.4.4.3 Nutrition-related factors and risk of CVD, 233
  8.4.4.3.1 Obesity, 233
  8.4.4.3.2 Diabetes, 234
  8.4.4.3.3 Dietary fat and cholesterol transport, 235
  8.4.4.3.4 Folic acid and plasma homocysteine, 237
  8.4.4.3.5 Antioxidant nutrients, 239
  8.4.4.3.6 Sodium and blood pressure, 240
8.4.5 Cancer, 242
  8.4.5.1 What is cancer?, 242
  8.4.5.2 Diet is a modifiable determinant of cancer risk, 244
  8.4.5.3 Nutritional epidemiology and cancer, 245
    8.4.5.3.1 Ecological studies, 245
    8.4.5.3.2 Migrant studies, 246
    8.4.5.3.3 Studies of populations with unique characteristics, 247
    8.4.5.3.4 Case–control studies, 247
    8.4.5.3.5 Cohort studies, 248
    8.4.5.3.6 Intervention studies, 248
    8.4.5.3.7 Cancer risk is a product of the whole diet, 248
  8.4.5.4 Dietary factors that may promote cancer, 249
    8.4.5.4.1 Obesity, 249
    8.4.5.4.2 Fat intake, 251
    8.4.5.4.3 Meat, 252
    8.4.5.4.4 Alcohol, 253
    8.4.5.4.5 Specific carcinogens in food, 253
  8.4.5.5 Dietary factors that may reduce cancer risk, 255
    8.4.5.5.1 Complex carbohydrates, 255
    8.4.5.5.2 Milk and dairy produce, 257
    8.4.5.5.3 Antioxidant nutrients, 257
    8.4.5.5.4 Folic acid, 259
    8.4.5.5.5 Non-nutrient components of plant foodstuffs, 260

9 Nutrition, ageing and the elderly, 268
  9.1 Introduction, 268
  9.2 The ageing population, 268
Appendix  An introduction to the nutrients, 300
A.1 Classification of nutrients, 300
A.2 Carbohydrates, 300
   A.2.1 Major roles, 300
   A.2.2 Structure and classification of carbohydrates, 300
   A.2.3 Digestion and absorption of carbohydrates, 301
A.3 Lipids, 302
   A.3.1 Major roles, 302
   A.3.2 Structure and classification of lipids, 302
      A.3.2.1 Fatty acids, 302
      A.3.2.2 Phospholipids and triglycerides, 303
   A.3.3 Digestion and absorption of lipids, 303
A.4 Proteins, 304
   A.4.1 Major roles, 304
   A.4.2 Amino acids, 304
   A.4.3 Structure of proteins, 305
   A.4.4 Digestion and absorption of proteins, 306
A.5 Micronutrients, 306
   A.5.1 Minerals, 306
   A.5.2 Vitamins, 308
Index, 309