Contents

This report is the collective work of all the members of the Task Force. Authors of the final draft of each chapter are given below.

Foreword                                      xvii
Terms of Reference                            xviii
Task Force Membership                         xix

1 Diet and Nutrition Issues Relevant to Older Adults                                      1
   Brigid McKevith
   1.1 Introduction                          1
   1.1.1 Demographics                      1
   1.2 Ageing and health                    3
       1.2.1 Causes of death                6
       1.2.2 Quality of life                7
   1.3 Ageing, gender and ethnicity        7
   1.4 Costs of an ageing population      9
   1.5 Nutritional requirements of older people and current recommendations    9
       1.5.1 Energy                          9
       1.5.2 Bodyweight                     10
       1.5.3 Macronutrients                 11
       1.5.4 Micronutrients                 12
       1.5.5 Fluid                          13
       1.5.6 Physical activity              13
   1.6 Food patterns, nutrient intakes and nutritional status of older people     14
       1.6.1 Food patterns                  14
       1.6.2 Nutrient intakes               16
       1.6.3 Nutritional status             18
   1.7 Determinants of food and nutrient intake and status in older people        20
       1.7.1 Ill health, disease and disability 21
       1.7.2 Poor dentition                 21
       1.7.3 Living in institutions         21
       1.7.4 Socio-economic status, poverty and economic uncertainty 22
       1.7.5 Drug–nutrient interactions    23
       1.7.6 Taste and smell                23
2 The Basic Biology of Ageing  26
Professor Thomas B.L. Kirkwood and Professor John C. Mathers
2.1 Definitions  26
2.2 Current understanding of ageing and its genetic basis  26
2.3 Mechanisms of cellular damage
  2.3.1 DNA damage and repair  28
  2.3.2 Telomeres  29
  2.3.3 Mitochondria  29
  2.3.4 Epigenetic changes  30
  2.3.5 Proteins  30
  2.3.6 Interactions between mechanisms  30
2.4 Metabolic factors affecting ageing  30
2.5 Energy (calorie) restriction in rodents  31
2.6 Early life effects  32
2.7 Nutrition and antioxidants  33
2.8 Nutrition and inflammation  33
2.9 Nutrigenomics  34
2.10 Conclusions  34
2.11 Key points  34
2.12 Recommendations for future research  35
2.13 Key references  35

3 Healthy Ageing: Teeth and the Oral Cavity  36
Professor Angus Walls
3.1 Changing oral health status with age  36
3.2 Impact of nutrition on oral disease
  3.2.1 Dental caries (tooth decay)  36
  3.2.2 Sugars consumption  39
  3.2.3 Erosion  43
  3.2.4 Antioxidants and periodontal disease  43
  3.2.5 Nutrients and oral mucosal health  43
  3.2.6 Alcohol  44
  3.2.7 Oral cancer  45
  3.2.8 Smoking  45
3.3 Impact of the oral environment on nutrition  45
  3.3.1 Chewing efficiency, digestion and foods choice  45
  3.3.2 Salivary changes with age and disease  48
3.4 Taste and smell
  3.4.1 Alterations in taste perception with age  50
  3.4.2 Alterations in olfactory perception with age  51
3.5 Texture  51
3.6 Key points  52
3.7 Recommendations for future research  53
3.8 Key references  53
## 4 Healthy Ageing: Bone Health

*Dr Nigel Loveridge and Dr Susan A. Lanham-New*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Introductory remarks</td>
<td>54</td>
</tr>
<tr>
<td>4.1.1 Defining bone health</td>
<td>54</td>
</tr>
<tr>
<td>4.1.2 Implications of osteoporosis from a public health perspective</td>
<td>54</td>
</tr>
<tr>
<td>4.1.3 Change in bone mass with ageing</td>
<td>54</td>
</tr>
<tr>
<td>4.1.4 Determinants of bone health: modifiable vs. non-modifiable factors</td>
<td>56</td>
</tr>
<tr>
<td>4.2 Nutritional influences on bone health</td>
<td>57</td>
</tr>
<tr>
<td>4.2.1 General</td>
<td>57</td>
</tr>
<tr>
<td>4.2.2 Calcium</td>
<td>57</td>
</tr>
<tr>
<td>4.2.3 Vitamin D status and health</td>
<td>61</td>
</tr>
<tr>
<td>4.2.4 Protein intake and bone health</td>
<td>62</td>
</tr>
<tr>
<td>4.2.5 Vitamin K</td>
<td>63</td>
</tr>
<tr>
<td>4.2.6 The effect of fruit and vegetables on bone health</td>
<td>64</td>
</tr>
<tr>
<td>4.2.7 Vegetarianism and bone health</td>
<td>67</td>
</tr>
<tr>
<td>4.2.8 Isoflavones and bone health</td>
<td>67</td>
</tr>
<tr>
<td>4.2.9 Vitamin A and bone</td>
<td>68</td>
</tr>
<tr>
<td>4.2.10 Folate and osteoporosis</td>
<td>68</td>
</tr>
<tr>
<td>4.2.11 Sodium</td>
<td>69</td>
</tr>
<tr>
<td>4.2.12 Alcohol and caffeine</td>
<td>69</td>
</tr>
<tr>
<td>4.2.13 Polyunsaturated fatty acids and bone health</td>
<td>69</td>
</tr>
<tr>
<td>4.2.14 Other key factors affecting bone health</td>
<td>69</td>
</tr>
<tr>
<td>4.3 Discussion</td>
<td>70</td>
</tr>
<tr>
<td>4.4 Key points</td>
<td>71</td>
</tr>
<tr>
<td>4.5 Recommendations for future research</td>
<td>72</td>
</tr>
<tr>
<td>4.6 Key references</td>
<td>73</td>
</tr>
</tbody>
</table>

## 5 Healthy Ageing: The Joints

*Professor Paul Dieppe*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Introduction</td>
<td>74</td>
</tr>
<tr>
<td>5.1.1 Background</td>
<td>74</td>
</tr>
<tr>
<td>5.1.2 Principles relating to associations between diet and arthritis</td>
<td>74</td>
</tr>
<tr>
<td>5.2 The inflammatory arthropathies</td>
<td>75</td>
</tr>
<tr>
<td>5.2.1 Diet and rheumatoid arthritis</td>
<td>77</td>
</tr>
<tr>
<td>5.2.2 Dietary fatty acids and inflammatory arthritis</td>
<td>77</td>
</tr>
<tr>
<td>5.2.3 Nutritional problems resulting from severe inflammatory arthritis</td>
<td>78</td>
</tr>
<tr>
<td>5.2.4 Gout and nutrition</td>
<td>78</td>
</tr>
<tr>
<td>5.3 Osteoarthritis</td>
<td>78</td>
</tr>
<tr>
<td>5.3.1 What is osteoarthritis (OA)?</td>
<td>78</td>
</tr>
<tr>
<td>5.3.2 Incidence and prevalence of OA</td>
<td>79</td>
</tr>
<tr>
<td>5.3.3 Risk factors for OA</td>
<td>80</td>
</tr>
<tr>
<td>5.3.4 Incident OA and progressive OA</td>
<td>80</td>
</tr>
<tr>
<td>5.3.5 Clinical features of OA</td>
<td>81</td>
</tr>
<tr>
<td>5.3.6 Joint pain in older people</td>
<td>81</td>
</tr>
<tr>
<td>5.3.7 Musculoskeletal disability in older people</td>
<td>82</td>
</tr>
<tr>
<td>5.3.8 The prevention and treatment of OA</td>
<td>82</td>
</tr>
<tr>
<td>5.4 Conclusion</td>
<td>85</td>
</tr>
<tr>
<td>5.5 Key points</td>
<td>86</td>
</tr>
<tr>
<td>5.6 Recommendations for future research</td>
<td>86</td>
</tr>
<tr>
<td>5.7 Key references</td>
<td>87</td>
</tr>
</tbody>
</table>
## Healthy Ageing: Skeletal Muscle

*Dr Emilie A. Wilkes and Professor Michael J. Rennie*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Introduction</td>
<td>88</td>
</tr>
<tr>
<td>6.2 Functions of skeletal muscle</td>
<td>88</td>
</tr>
<tr>
<td>6.3 Sarcopenia</td>
<td>89</td>
</tr>
<tr>
<td>6.3.1 Definition of sarcopenia and its prevalence</td>
<td>89</td>
</tr>
<tr>
<td>6.3.2 Onset of sarcopenia</td>
<td>91</td>
</tr>
<tr>
<td>6.3.3 Sex differences</td>
<td>93</td>
</tr>
<tr>
<td>6.3.4 Impact of birth weight</td>
<td>93</td>
</tr>
<tr>
<td>6.3.5 Effects of co-morbidity and smoking</td>
<td>94</td>
</tr>
<tr>
<td>6.4 Muscle fibre type composition and ageing</td>
<td>94</td>
</tr>
<tr>
<td>6.4.1 Muscle collagen</td>
<td>96</td>
</tr>
<tr>
<td>6.5 Proximal causes of age-related changes in skeletal muscle</td>
<td>96</td>
</tr>
<tr>
<td>6.5.1 Free radical theory of ageing</td>
<td>96</td>
</tr>
<tr>
<td>6.5.2 Mitochondrial damage theory</td>
<td>97</td>
</tr>
<tr>
<td>6.5.3 Inflammation theory of ageing</td>
<td>98</td>
</tr>
<tr>
<td>6.6 Ageing and glucose metabolism</td>
<td>98</td>
</tr>
<tr>
<td>6.7 Protein turnover</td>
<td>99</td>
</tr>
<tr>
<td>6.7.1 Muscle protein synthesis</td>
<td>99</td>
</tr>
<tr>
<td>6.7.2 Muscle protein breakdown</td>
<td>101</td>
</tr>
<tr>
<td>6.8 Implications for protein requirements</td>
<td>101</td>
</tr>
<tr>
<td>6.9 Caloric restriction</td>
<td>102</td>
</tr>
<tr>
<td>6.10 The effects of physical activity/exercise</td>
<td>102</td>
</tr>
<tr>
<td>6.11 Can nutraceuticals help maintain muscle mass?</td>
<td>103</td>
</tr>
<tr>
<td>6.12 Skeletal muscle spasms with progressive ageing</td>
<td>104</td>
</tr>
<tr>
<td>6.13 Summary and recommendations</td>
<td>104</td>
</tr>
<tr>
<td>6.14 Key points</td>
<td>105</td>
</tr>
<tr>
<td>6.15 Recommendations for future research</td>
<td>105</td>
</tr>
<tr>
<td>6.16 Key references</td>
<td>106</td>
</tr>
</tbody>
</table>

## Healthy Ageing: The Skin

*Dr Gail Jenkins, Dr Linda J. Wainwright and Dr Martin R. Green*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1 Introduction</td>
<td>107</td>
</tr>
<tr>
<td>7.2 Skin structure and function</td>
<td>107</td>
</tr>
<tr>
<td>7.2.1 Anatomy</td>
<td>107</td>
</tr>
<tr>
<td>7.2.2 Skin facts</td>
<td>108</td>
</tr>
<tr>
<td>7.2.3 Function</td>
<td>109</td>
</tr>
<tr>
<td>7.3 Intermediate metabolism</td>
<td>109</td>
</tr>
<tr>
<td>7.4 Skin research models</td>
<td>109</td>
</tr>
<tr>
<td>7.5 Vitamin D and health</td>
<td>110</td>
</tr>
<tr>
<td>7.6 Skin ageing</td>
<td>111</td>
</tr>
<tr>
<td>7.6.1 Skin ageing: clinical appearance and histology</td>
<td>111</td>
</tr>
<tr>
<td>7.6.2 Skin ageing: mechanisms</td>
<td>112</td>
</tr>
<tr>
<td>7.6.3 The role of telomeres in skin ageing</td>
<td>112</td>
</tr>
<tr>
<td>7.6.4 Neuroendocrine stress and skin ageing</td>
<td>112</td>
</tr>
<tr>
<td>7.6.5 Hormonal pathway interactions and skin ageing</td>
<td>112</td>
</tr>
<tr>
<td>7.7 Nutritional influences on skin health</td>
<td>113</td>
</tr>
<tr>
<td>7.8 Vitamins essential for skin</td>
<td>113</td>
</tr>
<tr>
<td>7.8.1 Vitamin A (retinol)</td>
<td>113</td>
</tr>
</tbody>
</table>
7.8.2 Vitamin C 114
7.8.3 The B vitamins 114
7.8.4 Vitamin D 115
7.8.5 Vitamin E 115
7.9 Nutrition, UV protection and skin ageing 115
7.9.1 Carotenoids and UV protection 115
7.9.2 Vitamins E and C and UV protection 116
7.9.3 Omega-3 fatty acids and sun protection 117
7.9.4 Polyphenols and sun protection 118
7.10 Nutrition and wound healing 118
7.10.1 Proteins and amino acids 118
7.10.2 Carbohydrates and fats 119
7.10.3 Vitamins 119
7.10.4 Trace elements 120
7.11 Dietary intake and skin conditions 120
7.12 Gene–nutrient interactions and skin 121
7.12.1 Vitamin A 121
7.12.2 Vitamin D 121
7.12.3 Peroxisome proliferator-activated receptors (PPARs) 121
7.12.4 Oestrogens and phytoestrogens 122
7.13 Skin nutrition: topical or dietary? 122
7.14 Key points 123
7.15 Recommendations for future research 123
7.16 Key references 124

8 Healthy Ageing: The Brain 125

Dr Robert Clarke

8.1 Introduction 125
8.2 Stroke 125
8.2.1 Blood pressure and risk of stroke 126
8.2.2 Dietary determinants of blood pressure 127
8.2.3 Homocysteine and risk of stroke 127
8.2.4 Randomised trials of B vitamin supplementation to prevent stroke and CHD 128
8.2.5 Cholesterol and risk of stroke 132
8.2.6 Antioxidants and risk of stroke 133
8.2.7 n-3 and n-6 fatty acids and risk of stroke 133
8.3 Dementia 133
8.3.1 Vitamin B12 and folate and risk of cognitive impairment and dementia 134
8.3.2 Possible hazards of folic acid 135
8.3.3 Oxidative stress and Alzheimer’s disease 137
8.3.4 Dietary fat and dementia 137
8.3.5 Blood pressure and risk of dementia 137
8.3.6 Aluminium and Alzheimer’s disease 138
8.3.7 Caffeine, alcohol and cognitive decline 138
8.3.8 Physical activity and dementia 138
8.4 Depression 138
8.5 Parkinson’s disease 139
8.5.1 Diet and Parkinson’s disease 139
8.6 Implications for research and public health 140
8.7 Key points 141
8.8 Recommendations for future research 141
8.9 Key references 142

9 Healthy Ageing: The Eye 143
Dr Astrid E. Fletcher

9.1 Introduction 143
  9.1.1 Refractive errors 143
  9.1.2 Cataract 144
  9.1.3 Age-related macular degeneration (AMD) 145
  9.1.4 Glaucoma 146
  9.1.5 Diabetic retinopathy 146
  9.1.6 Vision impairment in ethnic groups 147
9.2 AMD and cataract: classic conditions of ageing? 147
9.3 Brief review of structure and function of the lens 148
  9.3.1 Opacification of the lens 149
  9.3.2 The antioxidant defence system of the lens 149
9.4 Brief overview of retinal structure and function 149
  9.4.1 Light and the retina 150
  9.4.2 The antioxidant defence system in the retina 150
9.5 The role of diet: evidence from epidemiological studies 151
  9.5.1 Epidemiological evidence on external oxidative stress 152
  9.5.2 Antioxidants and lens opacities 152
  9.5.3 Body fat and lens opacities 154
  9.5.4 Antioxidants and AMD 154
  9.5.5 AMD and dietary fat 155
  9.5.6 Body fat and AMD 156
9.6 Role of diet: evidence from randomised trials 156
  9.6.1 Age-related macular degeneration 156
  9.6.2 Cataracts 156
9.7 Key points 157
9.8 Recommendations for future research 158
9.9 Key references 158

10 Healthy Ageing: The Cardiovascular System 159
Sara Stanner

10.1 Pathophysiology 159
10.2 The scale of the problem 159
10.3 Ageing and CVD risk 160
10.4 Risk factors for CVD in the general population 161
  10.4.1 ‘Classic’ risk factors 161
  10.4.2 ‘Emerging’ risk factors 164
  10.4.3 Risk factor clustering 165
10.5 Age trends in CVD risk factors 166
10.6 Relevance of CVD risk factors after the age of 65 years 168
  10.6.1 Dyslipidaemia and hypertension 168
  10.6.2 Obesity and diabetes 171
  10.6.3 The metabolic syndrome 172
10.6.4 Physical inactivity 172
10.6.5 The relevance of novel risk factors in old age 172
10.6.6 Periodontal disease and CVD 172

10.7 The role of dietary and nutritional factors in CVD prevention 173
10.7.1 Energy density 173
10.7.2 Dietary cholesterol 173
10.7.3 Dietary fat intake 173
10.7.4 Protein 178
10.7.5 Dietary fibre 179
10.7.6 Micronutrients 179
10.7.7 Specific foods associated with CVD risk 181
10.7.8 Alcohol 183
10.7.9 Dietary patterns and CVD risk 183
10.7.10 Diet–gene interactions 183
10.7.11 Current dietary recommendations in the UK 184

10.8 Physical activity and CVD 185
10.9 The need for a life-course approach 186
10.9.1 The fetal origins of adult disease (FOAD) hypothesis 186
10.9.2 Intergenerational influences 187

10.10 Treating and preventing CVD in the elderly 187
10.11 Key points 188
10.12 Recommendations for future research 189
10.13 Key references 190

11 Healthy Ageing: The Immune System 191

Dr Rosalyn J. Forsey, Julie M. Thompson, Dr Graham Pawelec and Dr Jonathan R. Powell

11.1 Overview of the immune system 191
11.2 Immune changes during ageing 192
11.2.1 Thymic involution 192
11.2.2 T-cell ageing 192
11.2.3 NK cell ageing 194
11.2.4 Macrophage ageing 194
11.2.5 Neutrophil ageing 194
11.2.6 B-cell ageing 194
11.2.7 Cytokines and ageing 195
11.2.8 Cytokine antagonists and ageing 195
11.2.9 Immune risk profile 196

11.3 Genetics and immune ageing 197

11.4 Inflammation and ageing 197
11.4.1 Ageing processes contribute to increased inflammation 197
11.4.2 External factors contribute to increased inflammation 198
11.4.3 Inflammation contributes directly to poor ageing 199

11.5 Immune ageing and infections 200
11.6 Immune ageing and cancer 200

11.7 Diet and lifestyle routes to control inflammation 201

11.8 Nutrition and immunity 202
11.8.1 Macronutrient deficiencies 203
11.8.2 Micronutrient deficiencies 203
11.8.3 Single micronutrient interventions 203
11.8.4 Micronutrient combination interventions 204
11.9 Key points 205
11.10 Recommendations for future research 206
11.11 Key references 207

12 Healthy Ageing: The Gastrointestinal Tract 208
Professor Ian R. Rowland and Professor John C. Mathers
12.1 Introduction 208
12.2 The oesophagus 208
12.2.1 Gastro-oesophageal reflux disease, Barrett’s oesophagus, achalasia 208
12.2.2 Oesophageal cancer 209
12.3 The stomach 211
12.3.1 Gastric pH 211
12.3.2 Gastric motility 212
12.3.3 Gastric and duodenal ulcer 212
12.3.4 Chronic atrophic gastritis and gastric cancer 213
12.4 The small intestine 215
12.4.1 Biology of the intestinal epithelium 215
12.4.2 Exocrine pancreas 218
12.4.3 Coeliac disease 218
12.4.4 Diarrhoea 218
12.5 The large intestine 220
12.5.1 The microflora of the large intestine 220
12.5.2 Constipation 222
12.5.3 Irritable bowel syndrome 224
12.5.4 Diverticular disease 225
12.5.5 Colorectal cancer 225
12.6 Key points 227
12.7 Recommendations for future research 228
12.8 Key references 229

13 Healthy Ageing: The Endocrine System 230
Brigid McKevith: Professor Judith L. Buttriss and Sara Stanner
13.1 Introduction 230
13.2 The endocrine system and the effects of ageing 231
13.2.1 The growth hormone/insulin-like growth factor-1 axis 232
13.2.2 Insulin and related hormones 232
13.2.3 Hormones relating to feeding 232
13.2.4 Sex hormones 233
13.2.5 Hormones related to bone health 234
13.2.6 Hormones related to muscle mass 235
13.2.7 The thyroid gland 235
13.2.8 Hormones related to stress 235
13.3 Effect of age-related changes in hormonal status on risk of disease 235
13.3.1 Diabetes 236
13.3.2 Cardiovascular disease (CVD) 236
13.3.3 Obesity 237
13.3.4 Cancer 237
13.3.5 Bone health 238
13.3.6 Sarcopenia  239
13.3.7 Stress  239

13.4 The influence of diet and physical activity on the endocrine system  239
13.4.1 Appropriate weight and physical activity  239
13.4.2 Carbohydrates and fibre  240
13.4.3 Plant-based diets  241
13.4.4 Phytoestrogen-containing foods  241
13.4.5 Fat  242
13.4.6 Protein  242
13.4.7 Iodine  243
13.4.8 Zinc  243
13.4.9 Other dietary components  243

13.5 Key points  244
13.6 Recommendations for future research  245
13.7 Key references  245

14 Taking the Science Forward: Public Health Implications  246
Professor Judith L. Buttriss

14.1 Introduction  246

14.2 Current trends in morbidity and quality of life  249
14.2.1 Common causes of morbidity during adulthood  249
14.2.2 Cardiovascular disease (CVD)  251
14.2.3 Dementia and depression  252
14.2.4 Obesity  252
14.2.5 Type 2 diabetes  254
14.2.6 Cancer  255
14.2.7 Osteoporosis  259
14.2.8 Arthritis and joint pain  259
14.2.9 Oral health  260
14.2.10 Other conditions  260

14.3 Summary of the Task Force’s findings for different organ systems  260
14.3.1 Teeth and the oral cavity  261
14.3.2 Bones  261
14.3.3 Joints  264
14.3.4 Muscle  264
14.3.5 Skin  265
14.3.6 Brain  266
14.3.7 Eyes  268
14.3.8 Cardiovascular system  269
14.3.9 Immune system  270
14.3.10 Digestive system  271
14.3.11 Endocrine system  274

14.4 Common themes  275

14.5 Current trends in diet and the way forward  275
14.5.1 Fruit and vegetables  275
14.5.2 Sugars, fibre, fat and salt  278
14.5.3 Vitamins and minerals  279
14.5.4 Fluid intake  280
14.5.5 Dietary patterns  282
14.5.6 Socio-economic, regional and ethnic differences  282
14.6 Current trends in physical activity and the way forward 283
14.7 Recommendations: life-course strategies 288
  14.7.1 Children and young adults 289
  14.7.2 Middle-aged adults and healthy older people 290
  14.7.3 Older people at nutritional risk 290
14.8 Key points 293
14.9 Key references 294

15 Conclusions of the Task Force 295
  15.1 Chapter 1 296
  15.2 Chapter 2 296
  15.3 Chapter 3 296
  15.4 Chapter 4 297
  15.5 Chapter 5 298
  15.6 Chapter 6 298
  15.7 Chapter 7 298
  15.8 Chapter 8 299
  15.9 Chapter 9 300
  15.10 Chapter 10 300
  15.11 Chapter 11 301
  15.12 Chapter 12 302
  15.13 Chapter 13 303
  15.14 Chapter 14 304

16 Recommendations of the Task Force 305
  16.1 Recommendations for the research community 305
    16.1.1 Ageing research in the UK 305
    16.1.2 Priorities for future research 306
  16.2 General recommendations to other key stakeholders 310
    16.2.1 The food industry 310
    16.2.2 Pharmaceutical and supplements industries 311
    16.2.3 Policy-makers and law enforcers 311
    16.2.4 Local authorities 312
    16.2.5 Health professionals and other educators 312

17 Healthy Ageing: Answers to Common Questions 313
  17.1 The causes and consequences of our ageing population 313
  17.2 The effect of ageing on diet and nutritional needs 314
  17.3 Impact of genes vs. environmental factors on life expectancy 314
  17.4 Ageing and oral health 315
  17.5 Ageing and bone health 317
  17.6 Effect of nutrient intake/status on bone health 318
  17.7 Ageing and joint health 319
  17.8 Ageing and muscle loss 321
  17.9 Ageing and skin damage 322
  17.10 Effect of lifestyle factors on stroke and cognitive function in later life 323
  17.11 Vision problems in ageing adults 324
  17.12 Nutrition and lifestyle factors and the ageing eye 325
  17.13 Ageing and cardiovascular disease 325
  17.14 Effect of diet and lifestyle on risk of cardiovascular disease 326
# Contents

17.15 Ageing and the immune system 327  
17.16 Ageing and the digestive system 328  
17.17 Ageing and hormones 330  
17.18 Dietary and lifestyle advice to promote healthy ageing 331  
17.19 Dietary interventions and policies 333  

Glossary 334  
References 345  
Index 415