

Index

Page numbers in *italics* refer to illustrations or tables

A

- acetyl-CoA carboxylase 1
 acetylation 26
 acne 46
 acrodermatitis enteropathica 225
 acute promyelocytic leukemia (APL) 46
 acyl-carrier protein 26
 adequate intake (AI) 248
see also specific nutrients
 adolescents
 calcium recommendations 125
 iodine deficiency 151
 iron deficiency 159
 ADP-ribosyl cyclases 17–18
 adrenal glands 248
 age-related macular degeneration (ARMD) treatment 246
 zinc 229
 AIDS 21, 248
 treatment 246
 selenium 209
 zinc 229
 alcohol interactions 40, 49, 241
 alcoholism
 folate deficiency and 8–9
 magnesium deficiency and 170
 thiamin deficiency and 36, 37
 aldehyde oxidase 187
 aldosterone 215
 allele 248
 allopurinol 241
 Alzheimer disease 243, 248
 prevention 243
 folic acid 13
 vitamin B₆ 54–55
 vitamin B₁₂ 65–66
 treatment 243
 thiamin 38
 vitamin E 100–101
 amino acids 248
 metabolism 8
 analog 248
 anaphylactic reactions 248
 thiamin 39
 anemia 32, 136, 248
 hemolytic 257
 hereditary 164
 iron deficiency 159
 macrocytic 259
 megaloblastic 9, 62, 260
 pernicious 60–61, 263
 sickle cell 266
 sideroblastic 266
 anencephaly 248
 angina pectoris 248
 angiography 248
 angiotensin 215
 antacid interactions 140, 166, 184, 194, 239
 anti-thiamin factors (ATFs) 37
 anti-tuberculosis medications 57
 antibiotic interactions 113, 230, 239
 antibodies 248–249
 anticoagulants 249
 interactions 40, 78, 103, 113
 anticonvulsants 249
 interactions 14, 103, 231, 239
 antidiuretic hormone (ADH) 215
 antigens 249
 antihistamine 249
 antioxidants 249
 copper function 135–136
 iron function 157
 manganese function 179
 selenium interaction 204, 211
 statin interactions 78–79, 211
 vitamin E interactions 103–104
see also specific antioxidants
 antiplatelet drug interactions 240
 apoptosis 249
 arginase 179
 ariboflavinosis 31–32
 ascorbate 77
see also vitamin C
 ascorbyl palmitate 77
 aspirin interactions 241
 asthma 243, 249
 magnesium treatment 174
 ataxia 97, 249
 atherosclerosis 111, 249
 prevention 244
 treatment 244
see also cardiovascular diseases
 ATP 249
 atrial fibrillation 249
 atrophic gastritis 61–62, 249
 autoimmune disease 249
 prevention 243
 vitamin D 89–90
- ## B
- bacteria 249
 biotin synthesis 4
 pantothenic acid synthesis 28
 vitamin K synthesis 112
 balance study 249
 beriberi 36–37, 38
 beta-carotene 42, 46–47
 bias 249
 bile 249–250
 bile acids 250
 bioavailability 250
 bioflavonoids 77
 biotin 1–5
 adequate intake 2, 2
 bacterial synthesis 4
 birth defects prevention 3
 deficiency 1–2
 disease treatment 3–4
 brittle fingernails 3–4
 diabetes mellitus 3
 hair loss 4
 drug interactions 5
 food sources 4, 4
 function 1
 nutrient interactions 4–5, 236
 recommendations 5
 toxicity 4
 biotin-deficient facies 2
 biotinidase deficiency 2
 birth defects
 prevention 247
 biotin 3
 folic acid 10–11
 vitamin A and 48
 bisphosphonate interactions 176, 240
 Bitot spots 44
 blood loss, iron deficiency and 159–160
 blood pressure regulation
 sodium chloride 215
 vitamin D 84–85
see also hypertension
 blood volume maintenance 215
 body mass index (BMI) 250
 bone development 179
 bone mineral density (BMD) 250
 fluoride and 143–144
 magnesium and 172
 potassium and 198
 sodium chloride and 216–217
 vitamin A effects 49
 vitamin D role 87–88
 vitamin K and 108, 110
see also osteoporosis
 bone remodeling 115, 250
 brain damage, iodine deficiency and 149, 150
 breast cancer prevention 243
 folic acid 12
 vitamin A 45–46
 vitamin B₁₂ 64–65
 vitamin C 72
 vitamin D 88–89
 vitamin E 99

- breast feeding
 calcium recommendations 126
 iodine deficiency and 151
 vitamin D deficiency and 85
- brittle fingernails, biotin treatment 3–4
- buffer 250
- C**
- caffeine, calcium balance and 117
- calcidiol 83
 see also vitamin D
- calcification 250
 phosphorus and 193–194
 vascular 111–112
- calcitriol 83, 115, 241
 see also vitamin D
- calcium 115–126
 deficiency 116
 disease prevention 118–121
 colorectal cancer 118
 kidney stones 119–120
 lead toxicity 120–121
 osteoporosis 118–119
 pregnancy-induced hypertension 120
 disease treatment 121
 hypertension 121
 premenstrual syndrome 121
 drug interactions 124–125
 function 115
 lead levels in supplements 123
 nutrient interactions 116–117, 125, 142, 147, 159, 170, 180, 224–225, 236–238
 phosphorus role in calcium balance 117, 191, 192
 prostate cancer risk and 124
 RDA 116, 118
 recommendations 125–126, 271
 regulation 115, 116
 sources 122–123, 122
 tolerable upper intake level 123
 toxicity 123
 vitamin D role 83, 84
 weight loss and 125
- calcium channel blocker interactions 240
- calmodulin 115
- cancer 12, 243, 250
 iron excess and 165–166
 prevention 243
 calcium 118
 folic acid 12
 niacin 19–20
 selenium 206–208
 vitamin A 45–46
 vitamin B₁₂ 64–65
 vitamin C 72–73
 vitamin D 88–89
 vitamin E 99
- treatment 243
 thiamin 39
 vitamin C 75
 vitamin E 101
 see also specific types of cancer
- carbohydrate 250
- chromium interactions 128–129
- carboxylation 250
 osteocalcin 110
- carcinogen 250
- carcinoid syndrome 250
- cardiac arrhythmias 244, 249
 see also cardiovascular diseases
- cardiomyopathy 250
- cardiovascular diseases 250
 iron excess and 165
 prevention 244
 chromium 130
 copper 137–138
 folic acid 11–12
 magnesium 171
 niacin 21
 selenium 208–209
 sodium chloride reduction 219
 vitamin B₆ 53–54
 vitamin B₁₂ 64
 vitamin C 71–72
 vitamin E 98
 vitamin K 111–112
 treatment 244
 magnesium 173
 vitamin C 74–75
 vitamin E 99–100
- carnitine 250, 271
- carotenoids 42
- carotid arteries 250
- carpal tunnel syndrome treatment 56, 245
- cartilage 250
- case reports 251
- case-control study 250–251
- catabolism 251
- cataract 251
 prevention 245
 riboflavin 33
 thiamin 38
 vitamin C 73
 vitamin E 98–99
- catecholamines 251
- celiac disease 160, 245, 251
- cell differentiation 83–84
- cell membrane 251
 membrane potential 196, 196, 214, 214
- cell migration 169
- cell signaling 115, 169, 251
- cerebrovascular disease 251
- ceruloplasmin 135, 136
- cardiovascular disease and 137, 138
- cervical intraepithelial neoplasia (CIN) 251
- chemotherapy 251
- children
 calcium recommendations 125
 iodine deficiency 151
 iron deficiency 159
 impaired intellectual development and 161
 manganese susceptibility 184
 zinc deficiency 226–227
 diarrhea susceptibility and 227
 effects on growth and development 226
 malaria susceptibility and 227
 pneumonia susceptibility and 227
- chloramphenicol 241
- chlorthalidone 176, 241
- cholecalciferol 83, 91
 see also vitamin D
- cholestatic liver disease 251
- cholesterol 251
 lowering 246
 niacin 21
 pantethine 27–28
- cholestryamine 241
- chorionic villous sampling (CVS) 251–252
- chromatin 252
- chromium 128–133
 adequate intake 129, 130
 deficiency 129
 diabetes treatment 131–132
 disease prevention 130
 cardiovascular diseases 130
 diabetes mellitus 130
 drug interactions 133
 function 128, 129
 health claims 130–131
 nutrient interactions 128–129, 236–237
 recommendations 133
 sources 132, 132
 toxicity 132–133
- chromosome 252
- chronic disease 252
- cirrhosis 252
- clinical trial 252, 263
- coagulation 252
 calcium role 115
 vitamin K role 107–108, 109
- cobalamin 60
 see also vitamin B₁₂
- coenzyme 252
- coenzyme A 26
- cofactor 252
 see also enzyme cofactors
- cognitive impairment
 prevention, folic acid 13
 iron, in children 161
 vitamin B₆ 54–55
 treatment, vitamin E 100–101
 see also dementia

- cohort study 252
 colchicine 241
 colestipol 241
 collagen 252
 colon 252
 colorectal cancer 252
 iron excess and 165–166
 prevention 243
 calcium 118
 folic acid 12
 vitamin D88
 common cold treatment 245
 vitamin C 76
 zinc 228
 intranasal preparations 228,
 230
 lozenges 228
 complement 252
 congestive heart failure 244, 252
 thiamin treatment 38–39
 see also cardiovascular diseases
 connective tissue formation,
 copper function 135
 copper 135–140
 deficiency 136–137, 230
 individuals at risk 137
 disease prevention 137–139
 cardiovascular diseases
 137–138
 immune system function
 138–139
 osteoporosis 139
 drug interactions 140
 function 135–136
 antioxidant functions
 135–136
 central nervous system 135
 connective tissue formation
 135
 energy production 135
 gene expression regulation
 135
 iron metabolism 135
 melanin formation 135
 nutrient interactions 136, 158,
 187, 224, 230, 237–238
 RDA 137, 137
 recommendations 140
 sources 139, 139
 tolerable upper intake level 140
 toxicity 139–140
 cornea 252
 coronary artery 252
 coronary heart disease (CHD)
 244, 252
 see also cardiovascular diseases
 creatine phosphate 252–253
 cretinism 150, 253
 Crohn disease 253
 cross-sectional study 253
 crossover trial 253
 cyanocobalamin 60, 67
 see also vitamin B₁₂
 cycloserine 241
 cystic fibrosis (CF) 253
 cytochromes 157
 cytochrome P450 (CYP) 253
 cytokine 253
 cytoplasmic retinoic acid-binding
 proteins (CRABPs) 43
- D**
- daily value (DV) 254
 decarboxylation 253
 dementia 253
 prevention 245
 vitamin B₁₂ 62, 65–66
 treatment 245
 vitamin E 100–101
 vascular 269
 see also Alzheimer disease
 dental caries 142, 253
 prevention 143, 245
 dental fluorosis 142, 146–147
 depletion–repletion study 253
 depression 245
 prevention 66, 245
 treatment 56, 245
 dermatitis 132, 253
 diabetes mellitus 253–254
 iron excess and 166
 prevention 245
 chromium 130
 manganese 181
 niacin 20
 selenium 209
 vitamin D 89
 treatment 245
 biotin 3
 chromium 131–132
 magnesium treatment
 173–174
 treatment 229
 vitamin C 75–76
 vitamin E 100
 zinc 229
 diabetic ketoacidosis 254
 dialysis 100, 254
 peritoneal 262–263
 diarrhea 44, 175, 227
 diastolic blood pressure 254
 dietary folate equivalents (DFEs)
 9–10
 dietary reference intake (DRI)
 254
 diethylenetriamine pentaacetate
 (DPTA) 241
 digoxin 241
 diuretic 254
 interactions 40, 231, 240
 diverticulitis 254
 DNA 254
 damage 132–133
 metabolism 7
 methylation 63
 synthesis 158
 transcription 268
- double blind 254
 doxorubicin 241
 DEXA 253
- E**
- echocardiography 254
 eclampsia 32, 247
 magnesium treatment
 172–173, 247
 ecological study 254
 electroencephalogram (EEG) 254
 electrolytes 254
 electron transport 157, 255
 endocrine system 255
 endothelial dysfunction, magne-
 sium treatment 173
 energy metabolism 157
 energy production 135, 169
 enzyme 255
 enzyme cofactors
 biotin 1
 calcium 115
 potassium 196
 vitamin B₁₂ 60
 epilepsy 255
 see also seizure
 ergocalciferol 83
 see also vitamin D
 erythropoietin 255
 esophagus 255
 see also gastroesophageal
 cancer
 estimated average requirement
 (EAR) 254
 estrogen 52, 255
 see also oral contraceptives
- F**
- familial adenomatous polyposis
 255
 fatty acid 255
 ferritin 158, 165, 166
 ferroxidase 135
 fetal development
 folic acid benefits 10–11, 15
 iodine deficiency 150
 vitamin A and 44, 48
 see also pregnancy
 fiber, magnesium status and 169
 fibroblastic breast condition 255
 iodine treatment 152–153
 fish oil 271
 flavin adenine dinucleotide (FAD)
 30, 31
 flavin mononucleotide (FMN) 30
 flavocoenzymes 30
 flavoproteins 30
 fluoride (fluorine) 142–147
 adequate intake 142, 143
 adverse effects 146–147
 deficiency 142

- disease prevention 143–144
 dental caries 143
 osteoporosis 143–144
 drug interactions 147
 function 142
 nutrient interactions 142, 237
 osteoporosis treatment 144
 recommendations 147
 sources 145–146, 145, 146
- fluorosis
 dental 142, 146–147
 skeletal 147
- 5-fluorouracil 24, 241
- folic acid 7–15
 deficiency 8–9, 62
 dietary folate equivalents (DFEs) 9–10
 disease prevention 10–13
 Alzheimer disease and cognitive impairment 13
 cancer 12
 cardiovascular diseases 11–12
 pregnancy complications 10–11, 15
 drug interactions 14–15
 function 7–8, 7
 genetic variation in requirements 10
 nutrient interactions 8, 225, 236
 RDA 9, 9
 recommendations 15
 sources 13, 14
 toxicity 14
- food-bound vitamin B₁₂ malabsorption 61
- fortification 255
- fractures *see* osteoporosis
- free radical 255
- fructose 256
 copper interaction 136
 phosphorus interaction 191
 function 7–8, 7
- G**
- G-proteins 17
- gallbladder 256
- gallstones 256
- Gas6 protein 108
- gastric bypass surgery 160
- gastric cancer 243
 salt consumption and 216
- gastroesophageal cancer 243
 molybdenum 188–189
- gastroesophageal reflux disease (GERD) 256
- gene expression 256
 copper role 136
 retinoic acid role 43, 43
- gestation 256
see also pregnancy
- gestation diabetes 247
- chromium supplementation 131–132
- gluconeogenesis 256
- glucose 256
- glucose tolerance impairment 258
 chromium and 128, 130
see also diabetes mellitus
- glucoside 256
- glutamate 179
- glutamine synthetase 179
- glutathione 256
- glutathione peroxidase 30, 203, 203
- glutathione reductase 30, 203
- glycogen 256
- glycoside 256
- glycosyltransferases 179
- goiter 149, 151, 154, 256
- goitrogens 151–152, 256
- gout 256
 prevention, vitamin C 73
- growth retardation 246
- zinc deficiency and 226
- GTP (guanosine triphosphate) 257
- H**
- H₂-receptor antagonist interactions 166, 240
- hair loss, biotin and 1, 4
- hallucination 2
- Hartnup disease 19, 257
- healthy eating 270
- healthy lifestyle 270
- heart disease *see* cardiovascular diseases
- Helicobacter pylori* infection 62, 72–73, 160, 216
- heme 257
- hemodialysis 257
- hemoglobin 52, 157, 159, 257
 glycated 256
- hemolysis 97, 257
- hemorrhage 257
 vitamin E and 102–103
- hepatitis 257
 liver cancer and 207
 niacin and 22–23
- hepatocellular carcinoma 165, 257
- hepatotoxicity, niacin 22–23
- hepcidin 158
- hereditary hemochromatosis 164, 257
- hereditary spherocytosis 257
- histone 257
 biotinylation 1
- HIV infection 257
 treatment 246
 niacin 21
 selenium 209
 zinc 229
- vitamin A effects on transmission 45
- HMG-CoA reductase inhibitors *see* statins
- holocarboxylase synthetase (HCS) 1
 deficiency 2
- homocysteine 8, 31, 244, 257
 Alzheimer disease and 65–66
 cardiovascular diseases and 11–12, 53–54, 64
 metabolism 8, 8, 54, 61
- homopantothenate 26
- hormone 257
- hydrolysis 257
- hydroxyapatite 115, 142, 191, 257
- hydroxylation 257
- hypercalcemia 91–92, 123
- hypercalciuria 123, 198–199
- hypercholesterolemia 21, 27–28, 246
- hyperglycemia 257
- hyperkalemia 194–195, 200, 201
- hypermagnesemia 175
- hybernemia 220
- hyperparathyroidism 257–258
 secondary 85
- hyperphosphatemia 193–194
- hypertension 74–75, 258
 prevention 246
 calcium 120
 magnesium 170–171
 pregnancy-induced hypertension 120
 vitamin D90
- sodium and 217–219
 clinical trials 217–219
 salt sensitivity 218
 target organ damage 219
 treatment 246
 calcium 121
 magnesium 172
 potassium 199
see also cardiovascular diseases
- hyperthyroidism 258
 iodine-induced (IHH) 154
- hypervitaminosis A 48
- hypervitaminosis D91
- hypoglycemia 258
- hypokalemia 197, 201
- hypomagnesemia 170, 173–174
- hyponatremia 215
 prolonged endurance exercise and 215–216
- hypoparathyroidism 258
- hypophosphatemia 192
- hypothalamus 258
- hypothyroidism 149, 151, 258
 congenital 150, 252
- hypoxia 157
- hypoxia inducible factors (HIFs) 157

- I**
- immune function 246
 - copper role 138–139
 - iron role 161–162
 - selenium role 206
 - vitamin A role 44
 - vitamin B₆ role 54
 - vitamin C role 74
 - vitamin D role 84
 - vitamin E role 99
 - infectious disease
 - iron and 161–162
 - selenium protective role 206
 - vitamin A protective role 44
 - deficiency effects 44–45
 - zinc and, children 227
 - diarrhea 227
 - malaria 227
 - pneumonia 227
 - see also immune function; specific diseases
 - inflammation 258
 - inflammatory bowel disease 258
 - vitamin D deficiency and 86
 - insulin 258
 - chromium function 128, 129
 - resistance 258
 - secretion 84
 - insulin-like growth factor-1 (IGF-1) 118
 - intervention trial 258
 - iodine 149–155
 - deficiency 149–150
 - developmental stage and 150–151
 - individuals at risk 152
 - drug interactions 154–155
 - fibrocystic breast condition
 - treatment 152–153
 - function 149
 - nutrient interactions 151–152, 204, 236–238
 - radiation-induced thyroid
 - cancer prevention 152
 - RDA 151, 152
 - recommendations 155
 - sources 153, 153
 - tolerable upper intake level 154
 - toxicity 153–154
 - iodine-induced hyperthyroidism (IHH) 154
 - iodothyronine deiodinases 204
 - ion channel 258
 - ion transport 169
 - iron 157–166
 - copper role in iron metabolism 135
 - deficiency 159
 - individuals at risk 159–160
 - symptoms 159
 - disease prevention 161–162
 - immune function 161–162
 - impaired intellectual development 161
 - lead toxicity 161
 - pregnancy complications 161
 - diseases associated with iron
 - excess 165–166
 - cancer 165–166
 - cardiovascular diseases 165
 - diabetes and metabolic syndrome 166
 - neurodegenerative disease 166
 - drug interactions 166
 - function 157–158
 - antioxidant and prooxidant functions 157
 - DNA synthesis 158
 - electron transport and energy metabolism 157
 - oxygen sensing 157
 - oxygen transport and storage 157
 - nonheme iron absorption
 - 162–163
 - enhancers 162
 - inhibitors 163
 - nutrient interactions 31, 44, 125, 128, 136, 158–159, 179–180, 224, 236–238
 - overload 164
 - RDA 160, 160
 - recommendations 166, 270
 - regulation 158
 - restless legs syndrome treatment 162
 - sources 162–163, 163
 - tolerable upper intake level 165
 - toxicity 164–165
 - iron regulatory proteins (IRPs) 158
 - isoniazid 24, 241
- J**
- jaundice 259
- K**
- Kashin–Beck disease 205
 - Keshan disease 205
 - ketoconazole 241
 - ketone bodies 259
 - kidney failure 133
 - kidney stones 259
 - prevention 246
 - calcium 119–120
 - potassium 198–199
 - vitamin B₆ 55
 - sodium and 217
 - vitamin C and 78
 - Korsakoff psychosis 36
- L**
- L-carnitine 271
 - lactation see breast feeding
 - laxative interactions 184, 240
- lead**
- in calcium supplements 123
 - toxicity prevention 246
 - calcium 120–121
 - iron 161
 - vitamin C 73–74
- left ventricular hypertrophy (LVH) 259**
- lethargy 2**
- leukemia 243, 259**
- acute promyelocytic (APL) 46
 - childhood, vitamin K relationship 109
- leukocytes 259**
- levodopa 241**
- levothyroxine 241**
- licorice 197**
- lipids 259**
- peroxidation 259
- lipoic acid 259, 271**
- lipoproteins 259**
- lithium 242**
- liver disease**
- biotin deficiency and 2
 - cancer
 - hepatitis infection and 207
 - iron excess and 165
 - selenium protective effect 207–208
 - cholestatic 251
 - manganese susceptibility and 183
- lovastatin 242**
- niacin interaction 23
 - see also statins
- low birth weights 11**
- lung cancer 132**
- prevention 243
 - selenium 207
 - vitamin A 45
 - vitamin C 72
 - vitamin E 99
- lymphocytes 259**
- lysyl oxidase 139**
- M**
- macular degeneration 246
 - zinc treatment 229
 - magnesium 169–176
 - deficiency 116, 170
 - disease prevention 170–172
 - cardiovascular diseases 171
 - hypertension 170–171
 - osteoporosis 171–172
 - disease treatment 172–174
 - asthma 174
 - cardiovascular diseases 173
 - diabetes mellitus 173–174
 - hypertension 172
 - migraine headaches 174
 - pre-eclampsia and eclampsia 172–173
 - drug interactions 176
 - function 169

- nutrient interactions 125, 142, 169–170, 180, 236–238
 RDA 170, 171
 recommendations 176, 271
 sources 174–175, 175
 tolerable upper intake level 175
 toxicity 175–176
 malabsorption syndrome 62, 260
 malaria 260
 susceptibility in children, zinc and 227
 manganese 179–184
 adequate intake 180, 180
 deficiency 180
 disease prevention 180–181
 diabetes mellitus 181
 osteoporosis 181
 seizure disorders 181
 drug interactions 184
 function 179
 individuals with increased susceptibility 183–184
 nutrient interactions 179–180, 237–238
 recommendations 184
 sources 181–182, 182
 tolerable upper intake level 184
 toxicity 182–183
 ingested manganese 183
 inhaled manganese 182–183
 intravenous manganese 183
 methylcyclopentadienyl manganese tricarbonyl (MMT) 183
 manganese superoxide dismutase (MnSOD) 179
 manganism 182
 matrix Gla protein (MGP) 108
 megaloblastic anemia 9, 62
 melanin formation, copper function 135
 membrane potential 214, 260
 potassium function 196, 196
 sodium chloride function 214, 214
 menaquinones 107, 112
 see also vitamin K
 Menkes disease 138
 menstruation 260
 meta-analysis 260
 metabolic syndrome 260
 iron excess and 166
 metabolism 260
 metabolite 260
 metallothionein 136, 224
 metformin 242
 methionine 8, 260
 methionine synthase 60
 impaired activity 62
 methionine-R-sulfoxide reductase 204
 methotrexate 242
 folic acid interaction 14
 methylation 260
 methylcrotonyl-CoA carboxylase 1
 methylcyclopentadienyl manganese tricarbonyl (MMT) 183
 methyl dopa 242
 methylene tetrahydrofolate reductase (MTHFR) 31, 31
 polymorphism 10, 12, 31
 methylmalonic acid (MMA) 62
 methylmalonyl-CoA mutase 60
 impaired activity 62
 migraine headache 260
 treatment 246
 magnesium 174
 riboflavin 33
 milk alkali syndrome 123
 mineral 260
 miscarriage 11
 mitochondria 260–261
 molybdenum 187–190
 deficiency 187–188
 drug interactions 189
 function 187
 gastroesophageal cancer prevention 188–189
 nutrient interactions 187
 RDA 188, 188
 recommendations 190
 sources 189
 tolerable upper intake level 189
 toxicity 189
 mono-ADP-ribosyltransferases 17
 multiple sclerosis (MS) 261
 prevention 247
 vitamin D 89–90
 multivitamin supplements 270
 muscle mass 130–131
 mutation 261
 myelin 261
 copper function 135
 myocardial infarction 261
 prevention 245
 treatment 245
 magnesium 173
 see also cardiovascular diseases
 myocarditis 261
 myoglobin 157, 159, 261
- N**
- natural killer (NK) cells 261
 nausea and vomiting in pregnancy treatment 56, 247
 necrosis 261
 neomycin 242
 neural tube defect (NTD) 261
 prevention 247
 folic acid 9, 10
 vitamin B₁₂ 65
 neurodegenerative disease 261
 iron and 166
 neurotransmitters 261
 copper function 135
- neutropenia 136, 138
 neutrophils 9, 261
 newborn infants
 iodine deficiency 150–151
 manganese susceptibility 183–184
 vitamin K deficiency 109
 niacin 17–24, 17
 deficiency 18
 causes of 19
 disease prevention 19–20
 cancer 19–20
 diabetes (type 1) 20
 disease treatment 21
 cardiovascular disease 21
 HIV infection 21
 drug interactions 23–24
 formation 52
 function 17–18
 HIV infection and 21
 nutrient interactions 19, 236
 RDA 19, 19
 recommendations 24
 sources 22, 22
 tolerable upper intake level 23
 toxicity 22–23
 nicotinamide
 insulin sensitivity and 20, 23
 toxicity 23
 nicotinamide adenine dinucleotide (NAD) 17, 31
 cancer and 19–20
 synthesis 18
 nicotinamide adenine dinucleotide phosphate (NADP) 17, 31
 nicotinic acid *see* niacin
 nitric oxide 261
 nitrous oxide 67, 242
 nonsteroidal anti-inflammatory drug (NSAID) interactions 14, 103, 240
 nucleic acids 261
 metabolism 7, 7
 synthesis 52, 63
 see also DNA; RNA
 nucleotides 262
 nutrient absorption 215
- O**
- obesity 262
 vitamin D deficiency and 86
 older adults, recommendations
 biotin 5
 chromium 133
 copper 140
 fluoride 147
 folic acid 15
 iodine 155
 iron 166
 magnesium 176
 manganese 184
 molybdenum 190
 niacin 24

- pantothenic acid 29
 phosphorus 195
 potassium 201
 riboflavin 35
 selenium 211
 sodium chloride 221
 thiamin 40
 vitamin A 49
 vitamin B₆ 58
 vitamin B₁₂ 68
 vitamin C 79
 vitamin D 92
 vitamin E 104
 vitamin K 113
 zinc 231
 immune function and 227
- olestra 242
 oral contraceptives
 interactions 15, 24, 29, 34, 240
 side effects treatment 55
 orlistat 242
 osteoarthritis 262
 osteoblasts 116, 262
 osteocalcin 108
 vitamin K-dependent
 carboxylation 110
 osteoclasts 115
 osteomalacia 85, 262
 osteoporosis 115, 262
 copper and 136–137, 139
 prevention 246
 calcium 118–119
 copper 139
 fluoride 143–144
 manganese 181
 potassium 198
 vitamin D 87–88
 vitamin K 110–111
 sodium chloride and 216–217
 treatment 246
 vitamin A and 49
 oxalate 122
 oxidation–reduction reactions
 17, 30, 30, 265
 oxygen sensing 157
 oxygen transport and storage
 157
- P**
- pancreas 262
 pantethine 27–29
 pantothenic acid 26–29
 adequate intake 27, 27
 deficiency 26–27
 disease treatment 27–28
 drug interactions 29
 function 26
 nutrient interactions 236
 recommendations 29
 sources 28, 28
 toxicity 28–29
 parathyroid glands 262
 parathyroid hormone (PTH) 115
 magnesium deficiency and 170
 phosphorus and 191–192
 Parkinson disease 262
 pellagra 18
 penicillamine 140, 231, 242
 peptic ulcer disease 262
 peripheral neuropathy 36, 97,
 262
 peripheral vascular disease 262
 pernicious anemia 60–61
 phenothiazine derivative interac-
 tions 240
 phenylketonuria (PKU) 263
 phenytoin 242
 phlebotomy 263
 phosphorus 191–195
 bone health and 191–192
 calcium balance and 117, 191,
 192
 deficiency 192
 drug interactions 194–195
 function 191
 nutrient interactions 191–192,
 238
 RDA 193, 193
 recommendations 195
 sources 193, 194
 tolerable upper intake level
 194
 toxicity 193–194
 phosphorylation 263
 phyloquinone 107, 112
 see also vitamin K
 phytic acid 122, 163
 pitiuitary 263
 placebo 263
 placenta 263–264
 placental abruption 11, 264
 plasma 264
 Plasmodium falciparum 227
 Plummer-Vinson syndrome 159
 pneumonia 264
 susceptibility in children, zinc
 and 227
 poly-ADP-ribose polymerases
 (PARPs) 17
 polymorphism 264
 polyp 264
 polyphenols 163
 potassium 196–201
 adequate intake 197, 197
 deficiency 197
 disease prevention 197–199
 kidney stones 198–199
 osteoporosis 198
 stroke 197–198
 drug interaction 201, 201
 function 196
 hypertension treatment 199
 nutrient interactions 238
 recommendations 201
 sources 199–200, 200
 toxicity 200
 adverse reaction to supple-
 ments 200
- potassium iodide 153
 pre-eclampsia 32, 264
 prevention 247
 calcium 120
 folate 11
 riboflavin deficiency and 32
 treatment 247
 magnesium 172–173
 pregnancy 246–247
 biotin deficiency and 2, 3
 calcium recommendations 126
 folic acid benefits 10–11, 15
 gestational diabetes 131–132
 iodine deficiency 151
 iron deficiency 159
 pregnancy complications and
 161
 nausea and vomiting treatment
 56
 pregnancy-induced hypertensi-
 on, calcium and 120
 vitamin A safety 48–49
 zinc deficiency 227–228
 premature delivery 11
 premenstrual syndrome (PMS)
 treatment
 calcium 121
 vitamin B₆ 55–56, 247
 prooxidant 264
 iron function 157
 propionyl-CoA carboxylase 1
 prostaglandins 208, 264
 prostate 264
 prostate cancer
 calcium and 124
 prevention 243
 selenium 207, 208
 vitamin D 89
 vitamin E 99
 prostate-specific antigen (PSA)
 264
 protein 264
 acetylation 26
 calcium balance and 117, 237
 magnesium absorption and
 169
 protein S 108
 proteoglycan 264–265
 proton pump inhibitor interac-
 tions 166, 240
 psoriasis 46, 265
 pyridoxal 5'-phosphate (PLP) 52
 see also vitamin B₆
 pyridoxine glucoside 56
 pyruvate carboxylase 1, 179
 pyruvate kinase deficiency 265
- Q**
- quinacrine 242
- R**
- R proteins 60
 radiation-induced thyroid cancer
 prevention 152

- randomized controlled trial (RCT) 265
- RDA (recommended dietary allowance) 265
see also specific nutrients
- reactive nitrogen species 265
- reactive oxygen species (ROS) 157, 265
see also antioxidants
- receptor 265
- red blood cell production
vitamin A role 44
vitamin B₆ role 52
- redox reactions 17, 30, 30, 265
- renal dialysis 100, 254
- renin-angiotensin-aldosterone system 215
- resorption 265
- response element 265
- restless legs syndrome (RLS) 162, 247
- retina 42, 265
- retinal 42
- retinitis pigmentosa 46, 97
- retinoic acid (RA) 42, 44
gene expression regulation 43, 43
- retinoic acid response elements (RAREs) 43
- retinoids 42
drug interactions 240
pharmacological doses 46
see also vitamin A
- retinol 42–43, 44
breast cancer and 45–46
see also vitamin A
- retinol activity equivalents (RAE) 46–47, 47
- retrospective study 266
- rhabdomyolysis 23
- rheumatoid arthritis (RA) 266
prevention 247
vitamin D 90
- riboflavin 30–35
cataract prevention 33
deficiency 31–32
risk factors 32
drug interactions 34
function 30
migraine treatment 33
nutrient interactions 31, 236–237
RDA 32, 32
recommendations 34–35
sources 34, 34
toxicity 34
- ribonucleotide 266
- rickets 85, 266
- rifampin 242
- RNA 266
translation 268
- S**
- S-adenosylmethionine (SAM) 7, 66
- salt *see* sodium chloride
- scurvy 70, 266
- seizure 266
prevention 247
manganese and 181
vitamin B₆ deficiency and 52–53
- selenium 203–211
deficiency 205
individuals at increased risk 205
disease prevention 206–209
cancer 206–208
cardiovascular diseases 208–209
diabetes mellitus 209
immune function 206
viral infection 206
drug interactions 211
function 203–204
HIV/AIDS treatment 209
nutrient interactions 151, 204, 236–238
RDA 205, 206
recommendations 211
sources 209–210, 210
toxicity 210–211
- selenophosphate synthetase 204
- selenoproteins 203–204
- selenosis 210
- sensory neuropathy 57
- Sep15 204
- serotonin 266
synthesis 52
- serum 266
- short bowel syndrome 266
- sickle cell anemia 266
- simvastatin
antioxidant interactions 78–79, 211
niacin interaction 23
vitamin E interaction 103–104
see also statins
- skeletal fluorosis 147
- skin diseases, retinoid treatment 46
see also specific diseases
- smoking 207
- sodium chloride 214–221
adequate intake 216, 216
adverse effects 220–221
calcium balance and 116–117
deficiency 215–216
disease prevention 216–219
cardiovascular diseases 219
gastric cancer 216
hypertension 217–219
kidney stones 217
osteoporosis 216–217
drug interactions 221
- function 214–215
blood volume and pressure 215
membrane potential 214
nutrient absorption 215
nutrient interactions 237, 238
recommendations 221
sources 219, 220
tolerable upper intake level 221
toxicity 219–220
- soy protein, iron absorption and 163
- spina bifida 266
- sprue 266–267
- statins
antioxidant interactions 78–79, 211
niacin interactions 23
vitamin E interaction 104–105
- steroid 267
- steroid hormone receptor 267
- steroid hormones 52
- stomach cancer prevention, vitamin C 72–73
- stroke 267
hemorrhagic 257
ischemic 258
prevention 245, 247
potassium 197–198
vitamin C 72
see also cardiovascular diseases
- sucralfate 242
- sulfasalazine 242
- sulfapyrazone 23–24, 242
- sulfite oxidase 187
deficiency 187–188
- sunlight, as vitamin D source 90
- superoxide dismutase (SOD) 135–136
- systematic review 267
- systolic blood pressure 267
- T**
- tannins 267
- testosterone 52
- tetany 267
- thalassemia 164
major 164, 267
minor 164, 268
- thiamin 36–40
cataract prevention 38
deficiency 36–37
causes of 37
disease treatment 38–39
Alzheimer disease 38
cancer 39
congestive heart failure 38–39
drug interactions 40
function 36
RDA 37, 38
recommendations 40
sources 39, 40
toxicity 39

- thiomolybdates 187
 thioredoxin reductase 203
 threshold 268
 thyroid 268
 function 149, 150
 thyroid cancer 154
 follicular 268
 papillary 268
 prevention 243
 iodine 152
 thyroid hormones 149
 deiodinases 204
 thyroid-stimulating hormone (TSH) 149, 154
 thyrotropin-releasing hormone (TRH) 149
 tocopherol 96
 alpha-tocopherol 96, 99
 supplements 102
 gamma-tocopherol 96–97
 supplements 102
 see also vitamin E
 tolerable upper intake level (UL) 268–269
 see also specific nutrients
 transcription factor 268
 transferrin 128
 receptor 158
 transient ischemic attack (TIA) 268
 transketolase 36
 triamterene 242
 tricyclic antidepressant interactions 240
 triglycerides 268
 trimethoprim 242
 troponin C 115
 tryptophan, niacin interaction 19, 236
 tuberculosis (TB) 268
 typhoid 268
- U**
- ulcerative colitis 268
- V**
- vascular calcification 111–112
 vasodilation, vitamin C treatment 74
 vegetarians
 iron deficiency 160
 zinc deficiency 225
 venous thromboembolism, vitamin E and 98
 virus 269
 viral infection 206
 vision 42, 42
 vitamin A function 42–43
 deficiency effects 44
 vitamin 269
 vitamin A 42–49
 bone mineral density (BMD)
 effects 49
 cancer prevention 45–46
 deficiency 44–45
 disease treatment 46
 drug interactions 49
 function 42–44
 gene expression regulation 43, 43
 growth and development 44
 immunity 44
 red blood cell production 44
 vision 42–43, 43
 nutrient interactions 44,
 112–113, 158, 225, 236–238
 RDA 45, 45
 recommendations 49, 270
 safety in pregnancy 48–49
 sources 46–48, 47
 tolerable upper intake level 48
 toxicity 48
 vitamin B₁, *see* thiamin
 vitamin B₂, *see* riboflavin
 vitamin B₃, *see* niacin
 vitamin B₅, *see* pantothenic acid
 vitamin B₆ 52–58
 deficiency 52–53
 disease prevention 53–55
 cardiovascular diseases 53–54
 cognitive function 54–55
 immune function 54
 kidney stones 55
 disease treatment 55–56
 carpal tunnel syndrome 56
 depression 56
 nausea and vomiting in pregnancy 56
 oral contraceptive side effects 55
 premenstrual syndrome 55–56
 drug interactions 57
 function 52
 nutrient interactions 31, 236
 RDA 53, 53
 recommendations 57–58
 sources 56–57, 56
 tolerable upper level 57
 toxicity 57
 vitamin B₁₂ 60–68
 deficiency 60–62
 causes 60–62
 symptoms 62
 disease prevention 64–66
 cancer 64–65
 cardiovascular diseases 64
 dementia 65–66
 depression 66
 neural tube defects 65
 drug interactions 67
 folic acid interaction 14
 function 60
 nutrient interactions 236
 RDA 63, 63
 recommendations 67–68
 sources 66–67, 66
 toxicity 67
 vitamin C 70–79
 deficiency 70
 disease prevention 70–74
 cancer 72–73
 cardiovascular diseases 71–72
 cataracts 73
 gout 73
 lead toxicity 73–74
 role in immunity 74
 disease treatment 74–76
 cancer 75
 cardiovascular diseases 74–75
 common cold 76
 diabetes mellitus 75–76
 drug interactions 78–79
 function 70
 nutrient interactions 128, 136,
 162, 236–238
 RDA 70, 71
 recommendations 79, 270
 sources 76–77, 76
 tolerable upper intake level 77
 toxicity 77
 kidney stones 78
 oxidative damage promotion 78
 with bioflavonoids 77
 vitamin D 83–92
 activation 83
 deficiency 85
 risk factors 85–86
 disease prevention 87–90
 autoimmune disease 89–90
 cancer 88–89
 hypertension 90
 osteoporosis 87–88
 drug interactions 92
 function 83
 blood pressure regulation 84–85
 calcium balance 83, 84, 116
 cell differentiation 83–84
 immunity 84
 insulin secretion 84
 mechanisms of action 83
 nutrient interactions 170, 191,
 236–238
 nutritional status assessment 86
 RDA 86, 87
 recommendations 92, 270
 sources 90–91, 91
 tolerable upper intake level 91
 toxicity 91–92
 vitamin D receptor (VDR) 83, 85
 vitamin D response elements (VDREs) 83

- vitamin E 96–104
 - deficiency 97
 - disease prevention 98–99
 - cancer 99
 - cardiovascular diseases 98
 - cataracts 98–99
 - immune function 99
 - disease treatment 99–101
 - cancer 101
 - cardiovascular diseases 99–100
 - dementia 100–101
 - diabetes mellitus 100
 - drug interactions 103–104
 - function 96–97
 - alpha-tocopherol 96, 99
 - gamma-tocopherol 96–97
 - nutrient interactions 112–113, 236–238
 - RDA 97, 98
 - recommendations 104, 270
 - sources 101–102, 101
 - supplementation related to mortality 103
 - tolerable upper intake level 103
 - toxicity 102–103
 - vitamin K 107–113
 - adequate intake 109, 110
 - childhood leukemia and 109
 - deficiency 109
 - disease prevention 110–112
 - cardiovascular disease 111–112
 - osteoporosis 110–111
 - drug interactions 113
 - function 107–108
 - bone mineralization 108
 - cell growth 108
 - coagulation 107–108
 - nutrient interactions 112–113, 236–237
 - premature infant doses 109
 - recommendations 113
 - sources 112, 112
 - toxicity 112
 - warfarin interaction 107, 108
- W**
- warfarin 242
 - fracture risk and 110–111
 - interactions 78, 103, 107, 108, 110–111, 113
 - water fluoridation 145
 - weight loss
 - calcium and 125
 - chromium and 131
 - Wernicke encephalopathy 36
 - Wernicke–Korsakoff syndrome (WKS) 36–37
 - Wilson disease 140
 - wound healing 27, 179
- X**
- xanthine oxidase 30, 187
 - xerophthalmia 44
- Z**
- zinc 224–231
 - deficiency 225
 - individuals at risk 225
 - disease prevention 226–228
 - immune function in elderly people 227
 - impaired growth and development 226
 - infectious disease in children 227
 - pregnancy complications 227–228
 - disease treatment 228–229
 - age-related macular degeneration 229
 - common cold 228
 - diabetes mellitus 229
 - HIV/AIDS 229
 - drug interactions 230–231
 - function 224
 - nutrient interactions 44, 136, 158, 169, 224–225, 236–238
 - RDA 226, 226
 - recommendations 231
 - sources 229–230, 231
 - tolerable upper intake level 230
 - toxicity 230
 - zinc finger motif 224
 - Zollinger–Ellison syndrome 269