

Phosphorus

Physiological Functions

Phosphorus is a component of bone, teeth, nucleic acids, phospholipids, ATP, and a number of enzymes and coenzymes. Phosphorylation of glucose is a requirement for its metabolism. Phosphorylation/dephosphorylation of cellular compounds is a mechanism for regulating enzyme activity and for transport and storage of cell compounds. Approximately 85% of the total body phosphate pool is found in bone as hydroxyapatite. The remaining amount of phosphate is distributed in blood and soft tissues. In the blood, phosphate is part of the monobasic-dibasic buffer system.

Factors Affecting Availability

Phosphorus is well absorbed by the intestines and does not change with changing needs. The total body phosphorus pool is regulated by renal excretion.

Beans, peas, cereals and nuts contain phytate or inositol phosphate which is resistant to digestion. However, phytase from yeast added during leavening of breads, can release some phosphate from phytate. Intestinal microflora can also release phosphate from phytic acid in the colon. Phytase activity from endogenous and exogenous sources can increase the bioavailability of phosphate from plant sources by approximately 50%.

Deficiency

Phosphorus deficiency caused by inadequate dietary intake does not occur. However, chronic and excessive use of anticonvulsants, calcium carbonate supplements, or aluminum hydroxide-containing antacids can decrease phosphate absorption. Hypophosphatemia can also develop in individuals with gastrointestinal malabsorption, diabetes mellitus, hyperparathyroidism, renal dysfunction, or alcoholism whether or not it is accompanied by decompensated liver disease. Hypophosphatemia results in bone loss, weakness, and poor appetite.

Toxicity

Elevated blood phosphorous levels are usually secondary to inadequate renal filtration due to acute or chronic renal failure.

Imbalances in phosphate intake may contribute to negative calcium balance when inadequate calcium intake is accompanied by excessive intake of phosphorous. Elevations in serum phosphate following a meal will inhibit activation of vitamin D which is necessary for stimulation of intestinal calcium absorption. In response to diminished levels of calcitriol, additional amounts of parathyroid hormone are secreted to compensate for interference with vitamin D activation by elevated serum phosphate. This condition is described as a nutritional secondary hyperparathyroidism which contributes to increased rates of bone turnover and eventually to a reduction of bone mass and density.

The upper intake levels of phosphorous intake for both men and women are 4,000 mg daily until age 70 after which the daily maximum is reduced to 3,000 mg.

❖ *The upper limit of safety for phosphorus established by the Food and Nutrition Board of the Institute of Medicine is 3-4 grams daily for adults. See table below for more age- and gender specific guidelines.*

Phosphorus Tolerable Upper Intake Levels	
Life Stage	Phosphate (g/day)
Infants	
0-6 mo	N/A
7-12 mo	N/A
Children	
1-3 y	3
4-8 y	3
Males, Females	
9-13 y	4
14-18 y	4
19-70 y	4
70 y	3
Pregnancy	
≤ 18 y	3.5
19-50 y	3.5
Lactation	
≤ 18 y	4
19-50 y	4

Dietary Requirements

The Daily Reference Intakes (DRI) for phosphorus are shown in the table below.

Phosphorus Requirements Daily Reference Intakes	
Life Stage	Phosphorus mg
Infants	
0-6 mo	100
7-12 mo	275
Children	
1-3 y	460
4-8 y	500
Males	
9-13 y	1250
14-18 y	1250
19-30 y	700
31-50 y	700
51-70 y	700
70 y	700
Females	
9-13 y	1250
14-18 y	1250
19-30 y	700
31-50 y	700
51-70 y	700
70	700
Pregnancy	
18 y	1250
19-30 y	700
31-50 y	700
Lactation	
18 y	1250
19-30 y	700
31-50 y	700

Dietary Sources

Good dietary sources of phosphorus are typically also rich in protein. These foods are mainly milk, meat, nuts, legumes, and grains. Additional dietary sources of phosphorus are listed in the table below.

Phosphorus Content of Food	
Food	Phosphorus

	(mg)
Pumpkin seed kernels, 1/4 cup	665
Sardines w/bones, 3.5 oz	425
Sunflower seeds, 1/4 cup	377
Low fat yogurt, 1 cup	352
Halibut, 3.5 oz ckd	285
Salmon or trout, 3.5 oz ckd	260
Sole, baked, 3 oz.	248
Nonfat milk, 1 cup	247
Chicken, light meat, 3.5 oz ckd	221
Beef steak, 3.5 oz cooked	218
Almonds, dry roasted, 1/4 cup	215
Split pea soup, 1 cup	213
Cheese, American, 1 oz.	211
Ham, 3 oz.	210
Ice milk, soft-serve, 1 cup	202
Lentils, 1/2 cup cooked	178
Oatmeal, 1 cup	178
Wheat germ, 1 Tbl	162
Navy or baked beans, 1/2 cup	155
Ground beef, 3.5 oz.	155
Peanuts, 1/4 cup	150
Tofu, regular, _ cup	120
Potato, baked, with skin, 1	115
Garbanzo beans, canned, _ cup	108