

21. Phosphorus

Physiology

Between 80 and 85 % (600-900 g) of phosphorus exists as phosphate in the calcium salt hydroxyapatite in the skeleton. The residue is in soft tissues as phosphate, mainly as a component of proteins, phospholipids and nucleic acids; 5-20 mmol (0.2-0.6 g) is present intracellularly in a large variety of phosphorylated compounds (e.g. adenosine triphosphate (ATP), guanosine triphosphate, etc.) which are needed for metabolic energy transfer and storage processes, enzyme activation and control. Furthermore via the interconversion of HPO_4^{2-} and H_2PO_4^- phosphorus contributes to extracellular and intracellular acid-base regulation.

Absorption occurs throughout the gut. At least 60 % of dietary phosphorus is absorbed; at least one carrier-mediated process and diffusional component is involved. The former mechanism is stimulated by calcitriol. Within the intestinal lumen complexes of phosphorus with minerals and amino acids may limit its uptake by the gut mucosa. Plasma inorganic phosphate concentration is normally 0.8-1.4 mmol/L. Homeostasis is achieved by urinary excretion, and there is a prompt increase of urinary phosphate in response to increased dietary intake ¹.

Deficiency and excess

Hypophosphataemia with intracellular depletion of phosphate is associated with muscle weakness and altered tissue oxygen tension, perhaps arising from defective synthesis of ATP and impaired delivery of oxygen to tissues as a consequence of depletion of red cell 2,3-diphosphoglycerate content. Prolonged moderate hypophosphataemia leads to osteomalacia. Excessive dietary intake is rare because renal excretion is efficient. In diseases prolonged hyperphosphataemia can result in abnormal calcification of soft tissues and acute hyperphosphataemia increases calcium binding and can precipitate features of hypocalcaemia including tetany. Although adults can tolerate varying Ca:P ratios in their diets without gross disturbances of their metabolism of calcium, infants cannot. A Ca:P molar ratio of 0.9-1.7 in diets for infants is considered safe.

Requirements

It is suggested that phosphorus intakes should correspond on a molar basis with those for calcium and rounded values are proposed accordingly.

Summary

<i>Adults</i>	mg/d
Average Requirement	400
Population Reference Intake	550
Lowest Threshold Intake	300

Population Reference Intakes of other groups

Age Group	PRI (mg/d)
6-11 m	300
1-3 y	300
4-6 y	350
7-10 y	450
<i>Males</i> 11-14 y	775
15-17 y	775
<i>Females</i> 11-14 y	625
15-17 y	625
Pregnancy	550
Lactation	950

References

1. Berner YN, Shike M. (1988). Consequences of phosphate imbalance. *Ann Rev Nutr.* **8**: 121-148.
2. Marshall DH, Nordin BEC, Speed R. (1976). Calcium, phosphorus and magnesium requirement. *Proc Nutr Soc*, **35**: 163-173.