

Vitamin B6

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Related nutrients/biomarkers: see below: importance of vitamin B6 for health

Importance of Vitamin B6 for health

Vitamin B6 is the general term for 6 water-soluble vitamins with vitamin B6 activity: pyridoxal (PL), pyridoxine (PN), pyridoxamine (PM), and their respective 5'-phosphate esters (PLP, PNP, PMP) (1-3). PLP is an essential cofactor for enzymes involved in numerous metabolic processes, which are categorized in 5 Fold Types (2):

- I. aspartate aminotransferase family
- II. tryptophan synthase family
- III. alanine racemase family
- IV. D-amino acid aminotransferase family
- V. glycogen phosphorylase family

Metabolic functions of PLP include (2, 4):

- Nervous system function
- Haemoglobin synthesis and function

- Tryptophan metabolism
- Hormone function
- Nucleic acid synthesis

Human are incapable of de novo vitamin B6 synthesis; thus, this vitamin needs to be provided through diet. Absorption is occurring in the jejunum by non-saturable, passive diffusion of the non-phosphorylated forms. PL is the main form that enters the portal circulation and binds to albumin for transport in the plasma. 75-80% of the circulating vitamin B6 is present as PL and PLP, with 60% of PLP located in the erythrocytes. Phosphorylation of the free forms is mainly located in the liver; a FMN-dependent oxidase converts PNP and PMP to PLP (4, 5).

Various foods contain good amounts of vitamin B6. Fish, beef liver and organ meats, potatoes and other starchy vegetables, and non-citrus fruit are good sources. A diverse dietary intake is estimated to result in a 75% bioavailability of this vitamin (2, 3).

Drug Interactions: Vitamin B6 metabolism is affected by certain medications (2):

- Oral contraceptives
- Anti-tuberculosis medications
- Penicillamine
- Anti-parkinsonian drugs
- Methylxanthines for respiratory conditions

Risks of deficiency:

Severe vitamin B6 deficiency is rare. Low vitamin B6 status is commonly associated with inadequate vitamin B12 and folate status. Reported deficiency symptoms include abnormal electroencephalogram patterns, seizures, neurologic disorders such as depression and confusion, inflammation on the tongue, sores and ulcers of the mouth and skin. Individuals with impaired renal function, autoimmune disorders, and alcoholics are at risk for vitamin B6 inadequacy (2, 3).

Risks of excess:

Symptoms of high vitamin B6 intake include sensory neuropathy, dermatological lesions, photosensitivity, and gastrointestinal symptoms, nausea, or heartburn. Tolerable Upper Limits are established by the Food and Nutrition Board (3).

Human biomarkers for measuring vitamin B6 intake and status

Vitamin B6 status can be assessed by different methods:

Biomarker	Analysis type	Sample	Benefits	Intricacies
B6 vitamers	Direct analysis	plasma	Good single B6 indicator	Slow response to intake
B6 vitamers	Direct analysis	RBC, WB	Status indicator	
Urinary B6	Direct analysis	Urine	Reflects dietary intake	
Functional B6	Indirect analysis		Enzyme activities	Assays may be affected by external factors

RBC: red blood cells; WB: whole blood

Direct analysis of vitamin B6

Direct analysis of B6 vitamers has been described in various matrices (1):

- Plasma, RBC, WB B6
 - Plasma B6 has been often measured by an apo-tryrosine decarboxylase assay. Chromatographic techniques have been used more recently for all type of blood samples.
- Urine
 - Includes the analysis of metabolites such as 4-pyridoxic acid often measured using HPLC.

Functional B6 assessment

Several PLP-dependent enzymatic processes have been used for vitamin B6 assessment (1):

- Erythrocyte aspartate aminotransferase (α -EAST) and alanine aminotransferase (α -EALT)
 - PLP-stimulation of α -EAST and α -EALT has been widely used to assess long-term B6 status
- Tryptophan catabolites
 - Urinary xanthurenic acid, normally a minor tryptophan catabolite increases under vitamin B6 depletion
- Plasma homocysteine
 - Homocysteine catabolism is a PLP-dependent process, thus homocysteine in plasma is related to vitamin B6 (and folate and B12)

Methods

- Chromatographic techniques for blood, plasma, erythrocyte, urine (5-8)

- α -EAST and α -EALT activities (9)
- Homocysteine in plasma (10)
- Tryptophan catabolites (11)

Accreditation schemes

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Vitamin B6, plasma: <https://www.labcorp.com/test-menu/36686/vitamin-b6-sub-plasma>

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Vitamin B6 (pyridoxal 5'-phosphate), serum: <http://ltd.aruplab.com/Tests/Pub/0080111>

Alternatively, please see the OpeN-Global page on laboratory accreditation: <https://open-global.kcl.ac.uk/accreditation/>

Technical assistance

For questions on methods of vitamin B6 assessment or for technical assistance, please contact the OpeN-Global team at <https://open-global.kcl.ac.uk/contact/> or write to:

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Useful links

US National Academies Press IOM Dietary reference intakes for thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline, 2000:

<http://nationalacademies.org/hmd/reports/2000/dietary-reference-intakes-for-thiamin-riboflavin-niacin-vitamin-b6-folate-vitamin-b12-pantothenic-acid-biotin-and-choline.aspx>

Linus Pauling Institute Micronutrient Information Center (Oregon State University), vitamin B6:

<https://lpi.oregonstate.edu/mic/vitamins/vitamin-B6>

NIH Health Information on vitamin B6: <https://ods.od.nih.gov/factsheets/VitaminB6-HealthProfessional/>

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