

Thiamin (vitamin B₁)

Physiological Functions

Thiamin is a coenzyme in two reactions involved in oxidative metabolism of glucose. The vitamin works in tandem with other niacin and riboflavin in glucose oxidation to yield useful metabolic energy in the form of ATP. Because nervous tissue is dependent solely on glucose for energy, these tissues are most sensitive to the effects of thiamin deficiency. Thiamin is also a cofactor in conversion of glucose to other sugars. This pathway is a major source of NADPH, a coenzyme required for biosynthesis of glucose and fatty acids.

Factors Affecting Availability

The requirement for thiamin is determined by the total amount of carbohydrate and energy consumed. Thiamin is also required for metabolism of alcohol by microsomal detoxification when intakes are high.

Thiamin is both water-soluble and heat-sensitive. Thus, losses of the vitamin are enhanced when sources are cooked at high temperatures in large volumes of liquid. Thiamin losses occur during milling of grains. To compensate for these losses, white flour and white rice are “enriched” with this vitamin to levels provided by whole grain sources.

Deficiency

Mild thiamin deficiency can result in difficulty in concentration, irritability, depression, muscle weakness and poor coordination. **Severe** thiamin deficiency known as beriberi is associated with mental confusion, and peripheral neuropathy. Edema characterizes the “wet” form of the disease while muscular atrophy, tachycardia, and cardiomegaly are characteristics of the “dry” form.

Thiamin-enriched grain products are widely available in the U.S. Consequently, clinical deficiencies are rarely observed except with severe alcoholism. Demands for thiamin are increased with excessive consumption of alcohol while typically both vitamin intake and absorption are decreased. Wernicke-Korsakoff Syndrome is a neurological condition that has been linked to thiamin deficiency among alcoholics. Symptoms can range in severity from delusion to psychosis. Brain lesions have been identified during autopsies of alcoholics suffering from this condition which resemble lesions found in animals with experimentally-induced thiamin deficiency. These lesions are thought to occur from accumulation of lactic acid that occurs when the thiamin-dependent step that bridges the nonoxidative pathway with the oxidative pathway of glucose metabolism is blocked.

Toxicity

Since thiamin is a water-soluble vitamin, amounts consumed in excess of needs are excreted in the urine so toxicity is rarely observed. Doses of thiamin administered parenterally in amounts 100 times the requirement have been reported to cause headache, convulsions, muscular weakness, cardiac arrhythmias, and allergic reactions.

- ❖ *The upper limit of safety for thiamin has not been determined due to lack of data substantiating adverse effects at high intakes. The Food and Nutrition Board of the Institute of Medicine recommends that thiamin should be consumed only from food sources to prevent intake of potentially toxic levels.*

Requirements

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

Life Stage	Thiamin (mg)
Infants	
0-6 mo	.2
7-12 mo	.3
Children	
1-3 y	.5
4-8 y symptoms of	.6
Males	
9-13 y	.9
14-18 y	1.2
19-30 y	1.2
31-50 y	1.2
51-70 y	1.2
70 y	1.2
Females	
9-13 y	.9
14-18 y	1.0
19-30 y	1.1
31-50 y	1.1
51-70 y	1.1
70	1.1
Pregnancy	
18 y	1.4
19-30 y	1.4
31-50 y	1.4
Lactation	
18 y	1.4
19-30 y	1.4
31-50 y	1.4

Dietary Sources

Thiamin is provided by consumption of whole grains, nuts, fish, pork, dried beans, and enriched grain products. See table below for dietary sources of thiamin.

Dietary Sources of Thiamin	
FOOD	Thiamin Content (mg)
Yeast, brewer's, 2 Tbl	2.3
Pork chop, lean, 3.5 oz	0.9
Ham, lean, 3.5 oz	0.7
Sunflower seeds, shelled, 1 oz	0.6
Wheat germ, raw, _ cup	0.6
Catfish, 3.5 oz cooked	0.4
Bagel, 2 oz enriched	0.4
Milk, soy, 1 cup	0.4
Pasta, enriched, 1 cup cooked	0.3
Beans, baked, 1 cup	0.34
Oatmeal, 1 cup cooked	0.26
Rice, white, enriched, cooked, 1 cup	0.26
Green peas, _ cup cooked	0.23
Potato, one medium baked	0.22
Orange juice, from frzn concl, 1 cup	0.20
Black beans, _ cup cooked	0.21
Navy beans, _ cup cooked	0.19
Soynuts, _ cup	0.20
Cashews, _ cup	0.15
Peanuts, _ cup	0.10