

Use of Dietary Supplements for Blood Sugar Regulation

Prevalence of Pre-diabetes and Type 2 Diabetes

Approximately 17 million Americans have type 2 diabetes, or 5.6% of the population, according to the US Dept. of Health & Human Services. Another 16 million are estimated to be pre-diabetic with impaired glucose tolerance. One of every 3 to 4 individuals (70 million), is likely to be insulin resistant and have increased risk to develop pre-diabetes, Syndrome X, or type 2 diabetes. Genetic predisposition is likely to be 50 percent responsible for insulin resistance, and lifestyle habits are likely to account for the other half.

Definition and Diagnosis of Pre-diabetes

The American Diabetes Association (ADA) has formally defined pre-diabetes as having either impaired fasting glucose (IFG) concentration between 110 and 126 mg/dL, or, impaired glucose tolerance (IGT) with a fasting glucose less than 126 mg/dL and plasma glucose concentration between 140 and 200 mg/dL 120 minutes after intake of 75 grams of oral glucose. The utility of the diagnosis of pre-diabetes is to initiate weight loss programs in overweight individuals, encourage increased physical activity in sedentary individuals, and to identify and treat the other coronary heart disease risk factors of dyslipidemia and hypertension which are increased in prevalence in these individuals. Each year, approximately 5% of all individuals within the pre-diabetic group progress into developing type 2 diabetes. The vast majority of pre-diabetic individuals, even if they don't develop type 2 diabetes, have manifestations of Syndrome X and increased risk of heart attack. According to a recent survey of physicians commissioned and reported by the ADA, "...of the more than 17 million people living with diabetes, 65 percent will die from a heart attack or stroke."

Lifestyle Modifications

Many scientists believe that calorie restriction, a healthy diet and weight loss combined with increased physical activity would be an effective means—possibly even more effective than drugs like metformin—to reduce the incidence of diabetes in those that are pre-diabetic, and there is definitive evidence to support that idea. Studies show that dietary changes alone can somewhat reduce risk of type 2 diabetes. Some studies have also shown that moderate alcohol intake among those who drink alcohol may decrease risk. Smoking worsens pre-diabetes, Syndrome X, and type 2 diabetes, as can certain prescription drugs for hypertension, which increase LDL cholesterol and triglyceride levels while lowering HDL cholesterol.

Use of Individual Supplements

Chromium

Description. Chromium is essential for normal binding of insulin to cell receptors and receptor activity. When insulin receptors are activated, a complex signaling system and set of reactions begin that result in the transport of glucose from plasma into cells.

Actions and Pharmacology. Chromium's mechanism of action is not fully understood. However, chromium may activate insulin receptor kinase activity and inhibit insulin receptor tyrosine phosphatase, leading to increased phosphorylation of the receptor and increased insulin sensitivity. Clinical studies have suggested that chromium

improves glucose tolerance. Chromium may also have anti-atherogenic effects through glucose regulatory mechanisms.

Usage and Dosage. From 200-1000 mcg daily. Chromium has been used safely in amounts up to 1000 mcg daily.

Research Summary. Since the mid-1960's, more than 30 studies have reported beneficial effects of supplemental chromium in people ingesting normal diets. However, not all studies conducted showed benefit. The response to chromium supplementation for glucose, insulin, and lipids is related to the amount and form of supplementation, duration, and degree of glucose tolerance in subjects. Recent studies using chromium supplementation ranging from 200-1000 mcg report improved glucose and insulin parameters in type 2 diabetics, and improved insulin sensitivity in healthy obese subjects with a family history of type 2 diabetes and overweight, exercising young women.

Contraindications, Precautions, Adverse Reactions. Generally, chromium supplementation is well tolerated. Pregnant women and nursing mothers should limit their intake to the recommended safe dose of 50-200 mcg per day, unless monitored by their physician. Those with type 2 diabetes mellitus should consult their physician so that their blood glucose levels can be appropriately monitored and medications adjusted, should their insulin resistance decrease.

Interactions: Drugs. Beta-blockers taken in conjunction with chromium may increase HDL-cholesterol levels.

Vanadium

Description. Vanadium is a trace mineral that may be life-essential.

Actions and Pharmacology. Research suggests that vanadium is essential to normal insulin function. Evidence is accumulating, showing that vanadium mimics insulin action in isolated cell systems.

Usage and Dosage. Range of 10 mcg to 1800 mcg. is considered safe. However, clinical studies with vanadium compounds have shown benefits in increasing insulin sensitivity in type 2 diabetics at a dosage of 100 milligrams vanadyl sulfate (31 mg elemental vanadium) daily for up to 4 weeks.

Research Summary. Studies demonstrate that vanadium significantly mimics insulin action and lowers plasma glucose at pharmacological doses in animals and humans with diabetes.

Contraindications, Precautions, Adverse Reactions, Interactions. No known contraindications at physiologic doses. Adverse reactions of diarrhea, green tongues, nausea, vomiting, and cramps are reported at dosage levels 4.5 to 22.5 mg per day. Ferrous ion, chloride, EDTA, chromium, and aluminum hydroxide may impair absorption of vanadium.

Magnesium

Description. Magnesium is an essential mineral affecting more than 300 metabolic functions and every biological process.

Actions and Pharmacology. Magnesium may have profound glucose-regulatory activity. The mechanism is unclear, but may affect insulin receptor binding or signal transduction.

Usage and Dosage. Studies show an inverse relationship between amounts of magnesium ingested and uptake, with lower amounts showing more efficacious absorption. Doses varied between 7 to 1,000 mg.

Research Summary. Supplemental magnesium has been shown to improve insulin response and glucose handling in the elderly and in type 2 diabetics. Several large scale, prospective studies have associated low serum magnesium with greater risk of developing type 2 diabetes, or have found that non-diabetics consuming the highest amount of magnesium can lower their risk of developing type 2 diabetes by about one-third, compared to those consuming the least magnesium.

Contraindications, Precautions, Adverse Reactions, Interactions. Ensure adequate levels. Contraindicated in people with heart block or renal failure. Amounts over 350 mg. may cause loose stool in some sensitive individuals.

Alpha-Lipoic Acid

Description. Alpha-lipoic acid is a compound involved in energy production, and is a powerful antioxidant.

Actions and Pharmacology. Alpha-lipoic acid is synthesized in the body, where it acts as an antioxidant with free radical scavenging activity, and is involved in the regeneration of antioxidants such as vitamins C, E, and glutathione. It may stimulate glucose transport.

Usage and Dosage. For treating diabetic neuropathy: 600-1200 mg daily. In Europe it is available for diabetic neuropathy in 300 mg doses, divided into 150 mg doses twice daily.

Research Summary. Experimental studies in cell culture and animal models of diabetes suggest that alpha-lipoic acid may stimulate glucose transport. Safety of large oral and intravenous doses has been demonstrated in clinical trials showing benefit in subjects with diabetic neuropathy. In studies of type 2 diabetics, large oral doses have been shown to improve insulin resistance or glucose effectiveness after 4 weeks of treatment.

Contraindications, Precautions, Adverse Reactions, Interactions. Pregnant women or nursing mothers should avoid alpha-lipoic acid supplements at pharmacologic doses. In general, it is well tolerated.

Taurine

Description. Taurine is a non-protein amino acid manufactured in the body. Dietary intake averages 40-300 mg daily.

Actions and Pharmacology. Taurine plays a role in detoxification, platelet function, central nervous system development, and acts as a membrane stabilizing antioxidant.

Usage and Dosage. Normal dosages range from 500 to 1000 mg.

Research Summary. Experiments have shown taurine to improve insulin sensitivity in animal models of insulin resistance and spontaneous type 2 diabetes. Some researchers have proposed that taurine supports glucose transport by its effects on membranes. Decreased nerve conduction velocity in diabetics is correlated with taurine depletion, and studies have shown that taurine supplementation prevents diabetic neuropathy and counters oxidative stress in animal models.

Contraindications, Precautions, Adverse Reactions, Interactions. No adverse reactions. Pregnant women and nursing mothers should consult their physicians before taking taurine.

Zinc

Description. Zinc is a mineral that plays a clear role in normal production, storage and secretion of insulin. It is necessary for the conformational integrity of insulin.

Actions and Pharmacology. Zinc is vital for numerous immune and metabolic functions, but its role and influence is not fully understood. It is known to have antioxidant activity.

Usage and Dosage. Deficiencies in zinc can lead to adverse health effects. Typical supplemental dose: 15 mg daily.

Research Summary. Studies have found that increased urinary loss of zinc is common in diabetes. Evidence also suggests that elevated glucose may induce higher intracellular levels of zinc-requiring antioxidant enzymes, and that zinc and chromium supplementation can significantly reduce biomarkers of oxidative stress in type 2 diabetics

Contraindications, Precautions, Adverse Reactions, Interactions. Doses up to 30 mg daily are well tolerated. Significantly higher doses may cause nausea, vomiting, headache, and sleepiness. A typical doses for pregnant women and nursing mothers is 15 mg daily.

Banaba/Colosolic Acid

Description. Colosolic acid is a triterpene compound derived from the *Lagerstroemia speciosa* plant, also known as banaba, from Southeast Asia. Used as a remedy for obesity and diabetes.

Actions and Pharmacology. Banaba extract has been reported to stimulate glucose transport, although how it exerts this action within the cellular insulin-signaling cascade is not known.

Usage and Dosage. Banaba may decrease blood glucose in type 2 diabetics. Studies have not established a recommended dosage. Take only with meals.

Research Summary. Most evidence of banaba's efficacy comes from safe, historical use by indigenous populations in Asia. Experimental studies have shown that colosolic acid and other components of banaba extract stimulate glucose transport activity in cultured cells. Other small placebo controlled studies have shown modest hypoglycemic effects in type 2 diabetics, and improved glucose and insulin response.

Contraindications, Precautions, Adverse Reactions, Interactions. No adverse reactions reported. Due to potential additive effects when taken in combination with insulin or drugs to manage type 2 diabetes, blood glucose levels should be monitored. Fasting or reactive hypoglycemics, type 1 diabetics, children, pregnant women and nursing mothers should not take banaba.

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