

DIABETES

Vitamin B12

Deficiency common in diabetics because metformin depletes B12.^{1,2}

Vitamin B3

Preserves B-cell function in type 1 diabetics; Part of GTF (glucose tolerance factor) which facilitates insulin binding.^{3,4,5}

Vitamin D

Lowers risk of type 1 and 2 diabetes; Suppresses inflammation of pancreatic B-cells; Vitamin D receptor gene linked to diabetes.^{6,7,8}

Vitamin E

Confers protection against diabetes by protecting pancreatic B-cells from oxidative stress induced damage; May prevent progression of type 1 diabetes.^{6,9}

Chromium

Helps insulin attach to cell's receptors increasing glucose uptake into cell; Deficiency can cause insulin resistance; Supplementation trials show dose-dependent benefits for type 2 diabetics.^{36,37,38}

Vitamin C

Lowers glycosylated hemoglobin (HbA1c) and fasting and post-meal glucose levels and in type 2 diabetics.^{10,11,12}

Biotin

Stimulates glucose-induced insulin secretion in pancreatic B-cells; High dose biotin can improve glycemic control in diabetics.^{33,34,35}

Inositol

Evidence suggests that inositol may be effective in treating diabetic neuropathy.^{13,14}

Magnesium

Deficiency reduces insulin sensitivity; Low magnesium exacerbates foot ulcers in diabetics.^{31,32}

Carnitine

Reduces and even prevents pain from diabetic neuropathy; Improves insulin sensitivity by increasing glucose uptake and storage.^{15,16,17,18}

Zinc

Needed in the synthesis, storage and secretion of insulin; Protects pancreatic B-cells from damage; Affects the expression of genes linked to diabetes.^{29,30}

Lipoic Acid

Enhances glucose uptake in skeletal muscle tissue; Improves glucose tolerance in type 2 diabetics; Very effective treatment for diabetic neuropathy.^{26,27,28}

Glutathione & Cysteine

Glutathione-containing enzymes protect B-cells which are particularly sensitive to oxidative stress; Type 2 diabetics have abnormal antioxidant status; Supplementation with the glutathione precursor cysteine restores antioxidant status.^{23,24,25}

Glutamine

Stimulates a hormone called GLP-1 (glucagon-like peptide 1) that regulates insulin secretion after meals; Improves insulin signaling and sensitivity.^{19,20}

Coenzyme Q10

Protects kidney from diabetes related damage; Improves glycemic control in type 2 diabetics.^{21,22}

REFERENCES

- ¹Pflipsen M, Oh R, Saguil A et al. The prevalence of vitamin B(12) deficiency in patients with type 2 diabetes: a cross-sectional study. *J Am Board Fam Med* 2009;22:528-534.
- ²Wulfele M, Kooy A, Leher P et al. Effects of short-term treatment with metformin on serum concentrations of homocysteine, folate and vitamin B12 in type 2 diabetes mellitus: a randomized, placebo-controlled trial. *J Intern Med* 2003;254:455-463.
- ³Pozzilli P, Browne P, Kolb H. Meta-analysis of nicotinamide treatment in patients with recent-onset IDDM. The Nicotinamide Trialists. *Diabetes Care* 1996;19:1357-1363.
- ⁴Greenbaum C, Kahn S, Palmer J. Nicotinamide's effects on glucose metabolism in subjects at risk for IDDM. *Diabetes* 1996;45:1631-1634.
- ⁵Visalli N, Cavallo M, Signore A et al. A multicentre randomized trial of two different doses of nicotinamide in patients with recent-onset type 1 diabetes (the IMDIAB VI). *Diabetes Metab Res Rev* 1999;15:181-185.
- ⁶Hyponene E. Micronutrients and the risk of type 1 diabetes: vitamin D, vitamin E and nicotinamide. *Nutr Rev* 2004;62:340-347.
- ⁷Liu E, Meigs J, Pittas A et al. Plasma 25-hydroxyvitamin D is associated with markers of the insulin resistance phenotype in nondiabetic adults. *J Nutr* 2009;139:329-334.
- ⁸Bailey R, Cooper J, Zeitels L et al. Association of the vitamin D metabolism gene CYP27B1 with type 1 diabetes. *Diabetes* 2007;56:2616-2621.
- ⁹Knekt P, Reunanen A, Marniemi J et al. Low vitamin E status is a potential risk factor for insulin-dependent diabetes mellitus. *J Intern Med* 1999;245:99-102.
- ¹⁰Dakhale G, Chaudhari H, et al. Supplementation of vitamin C reduces blood glucose and improves glycosylated hemoglobin in type 2 diabetes mellitus: a randomized, double-blind study. *Adv Pharmacol Sci* 2011;195271.
- ¹¹Afkhami-Ardekani M, Shojaoddiny-Ardekani A. Effect of vitamin C on blood glucose, serum lipids and serum insulin in type 2 diabetes patients. *Indian J Med Res* 2007;126:471-474.
- ¹²Yamada H, Yamada K, Waki M et al. Lymphocyte and plasma vitamin C levels in type II diabetic patients with and without diabetes complications. *Diabetes Care* 2004;27:2491-2492.
- ¹³Farias V, Macedo F, Oquendo M et al. Chronic treatment with D-chiro-inositol prevents autonomic and somatic neuropathy in STZ-induced diabetic mice. *Diabetes Obes Metab* 2011;13:243-250.
- ¹⁴Sima A, Dunlap J, Davidson E et al. Supplemental myo-inositol prevents L-fucose-induced diabetic neuropathy. *Diabetes* 1997;46:301-306.
- ¹⁵Mingrone G, Greco A, Capristo E et al. L-carnitine improves glucose disposal in type 2 diabetic patients. *J Am Coll Nutr* 1999;18:77-82.
- ¹⁶Molfino A, Cascino A, Conte C. Caloric restriction and L-carnitine administration improves insulin sensitivity in patients with impaired glucose metabolism. *J Parenter Enteral Nutr* 2010;34:295-299.
- ¹⁷Sima A et al. Acetyl-L-carnitine improves pain, nerve regeneration, and vibratory perception in patients with chronic diabetic neuropathy: an analysis of two randomized placebo-controlled trials. *Diabetes Care* 2005;28:89-94.
- ¹⁸Sima A. Acetyl-L-carnitine in diabetic polyneuropathy: experimental and clinical data. *CNS Drugs* 2007;21 Suppl 1:13-23.
- ¹⁹Greenfield J, Farooqi I, Keogh J et al. Oral glutamine increases circulating glucagon-like peptide 1, glucagon, and insulin concentrations in lean, obese, and type 2 diabetic subjects. *Am J Clin Nutr* 2009;89:106-113.
- ²⁰Reimann F, Williams L, da Silva Xavier G et al. Glutamine potently stimulates glucagon-like peptide-1 secretion from GLUTag cells. *Diabetologia* 2004;47:1592-1601.
- ²¹Sourris K, Harcourt B, Tang P et al. Ubiquinone (coenzyme Q10) prevents renal mitochondrial dysfunction in an experimental model of type 2 diabetes. *Free Radic Biol Med* 2012;52:716-723.
- ²²Mezawa M, Takemoto M, Onishi S et al. The reduced form of coenzyme Q10 improves glycemic control in patients with type 2 diabetes: An open label pilot study. *Biofactors* 2012 [Epub ahead of print].
- ²³Newsholme P, Rebelato E, Abdulkader F et al. Reactive oxygen and nitrogen species generation, antioxidant defenses, and β -cell function: a critical role for amino acids. *J Clin Endocrinol* 2012;214:11-20.
- ²⁴De Mattia G, Bravi M, Laurenti O et al. Influence of reduced glutathione infusion on glucose metabolism in patients with non-insulin-dependent diabetes mellitus. *Metabolism* 1998;47:993-997.
- ²⁵Sekhar R, Patel S, Guthikonda A et al. Deficient synthesis of glutathione underlies oxidative stress in aging and can be corrected by dietary cysteine and glycine supplementation. *Am J Clin Nutr* 2011;94:847-853.
- ²⁶Porasuphatana S, Suddee S, Nartnampong A et al. Glycemic and oxidative status of patients with type 2 diabetes mellitus following oral administration of alpha-lipoic acid: a randomized double-blinded placebo-controlled study. *Asia Pac J Clin Nutr* 2012;21:12-21.
- ²⁷Ziegler D, Ametov A, Barinov A et al. Oral treatment with alpha-lipoic acid improves symptomatic diabetic polyneuropathy: the SYDNEY 2 trial. *Diabetes Care* 2006;29:2365-2370.
- ²⁸Ansar H, Mazloom Z, Kazemi F et al. Effect of alpha-lipoic acid on blood glucose, insulin resistance and glutathione peroxidase of type 2 diabetic patients. *Saudi Med J* 2011;32:584-588.
- ²⁹Jansen J, Karges W, Rink L. Zinc and diabetes – clinical links and molecular mechanisms. *J Nutr Biochem* 2009;20:399-417.
- ³⁰Sun Q, van Dam R, Willett W et al. A prospective study of zinc intake and risk of type 2 diabetes in women. *Diabetes Care* 2009;32:629-634.
- ³¹Takaya J, Higashino H, et al. Intracellular magnesium and insulin resistance. *Magnes Res* 2004;17:126-136.
- ³²Rodriguez-Moran M, Guerrero Romero F. Low serum magnesium levels and foot ulcers in subjects with type 2 diabetes. *Arch Med Res* 2001;34:300-303.
- ³³Albarracin C, Fuqua B, Evans J et al. Chromium picolinate and biotin combination improves glucose metabolism in treated, uncontrolled overweight to obese patients with type 2 diabetes. *Diabetes Metab Res Rev* 2008;24:41-51.
- ³⁴Furukawa Y. Enhancement of glucose-induced insulin secretion and modification of glucose metabolism by biotin. *Nippon Rinsho* 1999;57:2261-2269.
- ³⁵Larrieta E, de la Vega-Monroy M, Vital P et al. Effects of biotin deficiency on pancreatic islet morphology, insulin sensitivity and glucose homeostasis. *J Nutr Biochem* 2012;23:392-399.
- ³⁶Broadhurst C, Domenico P. Clinical studies on chromium picolinate supplementation in diabetes mellitus—a review. *Diabetes Technol Ther* 2006;8:677-687.
- ³⁷Hua Y, Clark S, Ren J et al. Molecular mechanisms of chromium in alleviating insulin resistance. *J Nutr Biochem* 2012;23:313-319.
- ³⁸Cefalu W, Rood J, Pinsonat P et al. Characterization of the metabolic and physiologic response to chromium supplementation in subjects with type 2 diabetes mellitus. *Metabolism* 2010;59:755-762.

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