Asparagine Glutamine Supplementation of this amino acid delayed Biotin Mental and physical fatigue coincides fatigue during exercise by decreasing the Helps liver utilize glycogen for with reduced levels of this amino acid rate at which glycogen was used up; needed energy. Animal studies confirm in various tissues. Supplementation for gluconeogenesis, a process that allows that biotin deficiency causes Zinc makes muscle more sensitive to glucose to be made from protein to prevent clinical fatigue.4 Deficiency lowers immunity insulin, increasing energy levels.5,6,7 blood sugar from getting too low.^{1,2,3} and may cause muscle fatigue; Involved in several reactions for energy metabolism. 15,34,35 Chromium Promotes glucose uptake into cells, helping stabilize blood sugar. 16,33 **FATIGUE** Carnitine Transports fatty acids into mitochondria; Decreases both mental and physical fatigue in clinical trials. 27,28,29, **B** Vitamins Necessary for converting food into energy; Cofactors in the mitochondrial respiratory chain include B1, B2, B3, B5, B6, B12 and Folate.8,15,16,26,30

Vitamin D

Low levels are seen in patients with chronic fatigue syndrome; Deficiency causes reduced muscle strength.^{24,25} Vitamin E

Inverse correlation exists between fatigue and vitamin E levels.²³ Vitamin A

When cellular levels of vitamin A are low, mitochondrial respiration and ATP production decreases.²² Vitamin C

Assists iron uptake and transport; Precursor to carnitine and several hormones that affect energy levels. Supplementation reduced fatigue in various trials. 15,1621

Serine

Counteracts the overproduction of fatigue-causing stress hormones.^{8,9}

Coenzyme Q10

Deficiency causes fatigue due to its role in mitochondrial energy metabolism; therapeutic benefits particularly noticeable in chronic fatigue syndrome. 10,11,12,15

Fructose Intolerance

Fatigue (and hypoglycemia) are classic symptoms of this condition, since it depletes the main form of cellular energy,ATP. ^{13,14}

Magnesium

Required to store energy molecule ATP; Repletion of magnesium in chronic fatigue patients shows clinical improvement in energy levels. 15,16,17

Antioxidants

Several studies confirm that oxidative stress exacerbates clinical symptoms of fatigue. Mitochondrial dysfunction (inefficient energy metabolism) can be treated therapeutically with antioxidants such as Selenium, Cysteine, a-Lipoic acid and Glutathione, of which unusually low levels are seen in chronic fatigue patients. 12.16.18.19.20

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