NatMed
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Coenzyme Q10

SCIENTIFIC NAME
Ubiquinol, Ubiquinone, Ubidecarenone, read more...

FAMILY

Other Common Names

- Coenzima Q-10, Coenzyme Q-10, CoQ10, Ubidécarénone, Ubiquinone-10.

Overview

Coenzyme Q10 is a fat-soluble compound with a chemical structure similar to vitamin K (7000,11892). It contains a quinone ring with 10 isoprenoid units attached, hence the term "Q10". The highest concentrations of endogenous coenzyme Q10 are found in the heart, liver, kidney, and pancreas (7000). There are two physiological forms of coenzyme Q10 that are also available as supplements: the oxidized form (ubiquinone) and the reduced form (ubiquinol) (95707).

Safety

LIKELY SAFE ...when used orally and appropriately. Coenzyme Q10 has been used safely in studies lasting up to 5 years (2134,6037,6038,6407,8163,8938,8939,8940,15395,17413,17716,96538)(109391). ...when used topically on the gums (2107,2108,8916,8917,8918).

CHILDREN: **POSSIBLY SAFE** ...when used orally and appropriately. Coenzyme Q10 in doses of 1-10 mg/kg/day has been used safely for up to 9 months under medical supervision (12199,13223,15256,44005,107449).

PREGNANCY: **POSSIBLY SAFE** ... when used orally and appropriately. Coenzyme Q10 100 mg twice daily has been used with apparent safety during pregnancy, starting at 20 weeks gestation until term (17201).

LACTATION: Insufficient reliable information available; avoid using.

Adverse Effects

General: Orally, coenzyme Q10 is generally well tolerated. In clinical studies, no serious adverse effects have been reported.

Most Common Adverse Effects:

Orally: Gastrointestinal side effects such as appetite suppression, diarrhea, epigastric discomfort, heartburn, nausea,

and vomiting. These generally occur in less than 1% of patients. Some of these adverse effects can be minimized if daily doses above 100 mg are divided.

- ## Cardiovascular

  Palpitations have been reported as being possibly associated with coenzyme Q10 treatment (89421). Death due to myocardial infarction occurred in one Parkinson disease patient taking coenzyme Q10; causality is unclear (15395).

- ## Dermatologic

  Two of 143 participants in a case series reported skin itching after starting treatment with oral coenzyme Q10 (6047). Allergic rash has also been reported (6409,11872). An itching exanthema was seen in two heart failure patients treated with intravenous coenzyme Q10 (44284).

- ## Gastrointestinal

  Gastrointestinal side effects of coenzyme Q10 have included nausea (3365,6409,8907,10152,43982,44172,44179,44330,89421,109392), vomiting (3365,10152,44330,89421), epigastric discomfort (3365,44179,44330,89421), constipation (109392), diarrhea (44179,92904,89421,109392), stomach upset (8940,12170,109387,109388,109392), loss of appetite (2121), heartburn (2121,44179,109392), and flatulence (43982), although this occurs in less than 1% of patients. In one clinical study, gastrointestinal bleeding in association with angiodysplasia has been reported to be possibly related to coenzyme Q10 treatment (89421).

- ## Genitourinary

  An uncomplicated urinary infection was reported in a patient taking oral coenzyme Q10 (nanoQuinon, MSE Pharmazeutika) (44020).

- ## Hematologic

  Thrombocytopenia was noted in one patient treated with oral coenzyme Q10 (44296); however, other factors (viral infection, other medications) may have been responsible for this adverse effect.

- ## Musculoskeletal

  Increased plasma creatine kinase with high-intensity exercise has been reported in patients taking coenzyme Q10 (44303). Muscle pain has been reported rarely in one clinical trial (109392).

- ## Neurologic/CNS

  Headache and dizziness have been reported in human research (3365,11872,43982,44330,109392). Insomnia has been reported as being possibly associated with coenzyme Q10 treatment (89421). Cognitive decline, depression, and sudden falls were reported rarely in a clinical trial of patients with Huntington disease (8940). Increased lethargy was reported for one patient treated with oral coenzyme Q10 (44042). Feeling of internal trembling has been reported in a clinical trial for one patient treated with coenzyme Q10 (44020).

- ### Ocular/Otic

  Visual sensitivity to light has been reported for a patient treated with coenzyme Q10. However, the association of this effect with coenzyme Q10 treatment was not clear (6409).

  A burning sensation has been reported for 10% of patients treated with a topical eye solution containing coenzyme Q10 and alpha-tocopheryl polyethylene glycol 1000 succinate following cataract surgery (44228).

- ### Psychiatric

  Worsening depression has been reported as being possibly associated with oral coenzyme Q10 treatment (89421).

- ### Pulmonary/Respiratory

  Drug-induced pneumonitis was diagnosed in a 61 year-old woman who had been taking coenzyme Q10 and perilla leaf extract for two months (43978). Symptoms improved after she stopped taking the supplements and began taking oral prednisone. Causation from coenzyme Q10 was unclear.

- ### Other

  In a case report, a naval aviator using a supplement containing coenzyme Q10 and niacin had reduced G tolerance (44186). G tolerance was regained with cessation of the supplement.

Effectiveness

LIKELY EFFECTIVE

Coenzyme Q10 deficiency. Taking coenzyme Q10 orally improves symptomatic deficiency.

Details: Rare cases of acquired coenzyme Q10 deficiency with symptoms of weakness, fatigue, and seizures have been reported (8160,8161). In adults, deficiency can be treated with coenzyme Q10 orally, 150-2400 mg daily in up to three divided doses. In children, 30 mg/kg, or 60-250 mg daily in up to three divided doses has been used (8160,8161,89417).

Data from several multinational disease registries has also evaluated the use of coenzyme Q10 in patients with primary coenzyme Q10 deficiency, a rare genetic disorder. This data indicates that patients who take coenzyme Q10 supplements have a mean reduction of 88% in proteinuria at 12 months when compared with patients who do not take coenzyme Q10. In patients under 18 years of age with primary deficiency and chronic kidney disease at baseline, taking coenzyme Q10 supplements is associated with a 5-year survival without kidney failure of 62%, compared with 19% for those not taking coenzyme Q10 (108956).

Mitochondrial myopathies. Taking coenzyme Q10 orally seems to reduce symptoms in some patients with genetic and acquired mitochondrial dysfunction.

Details: A specific coenzyme Q10 formulation (UbiQGel, Tishcon Corporation) has been evaluated for mitochondrial myopathies, including MELAS (myoclonic epilepsy with lactic acidosis and stroke-like episodes) syndrome, Kearns-Sayre syndrome, and MERRF (myoclonus epilepsy with ragged red fibers). Typical doses are 150-160 mg, or 2 mg/kg, daily, gradually increasing to 3000 mg daily in some cases. The onset of action is slow, with maximal effects around 6 months (8159,8162,8163,8912,11050,44240,97905).

POSSIBLY EFFECTIVE

Congestive heart failure (CHF). Oral coenzyme Q10 may provide benefit to patients with CHF by improving some, but not all, measures of disease severity when given in combination with conventional therapy.

Details: Population research has found that CHF is associated with low coenzyme Q10 levels that correlate with severity of disease, and may be a predictor of mortality risk (44059,44220). A 2017 meta-analysis of clinical research shows that taking coenzyme Q10 30-300 mg, or 2 mg/kg, orally daily in two or three divided doses for up to 2 years, in addition to conventional therapy, improves exercise capacity, reduces hospitalizations, and reduces mortality by about 30% when compared with placebo. Other clinical research shows that adding oral coenzyme Q10 seems to improve quality of life and decrease symptoms of CHF such as dyspnea, peripheral edema, enlarged liver, and insomnia in patients with mild to severe (New York Heart Association (NYHA) class II-IV) CHF (6037,6038,6407,6408,6409,8909,12170,43967,43971,44042)(44277,44288,44289,44304,44334,44352,95610,96542). Additional clinical research shows that taking coenzyme Q10 30 mg daily for 1 year in addition to standard care reduces the incidence of atrial fibrillation by about 73% when compared with standard care alone in patients with NYHA class II-IV CHF (95609).

However, not all evidence is positive. Some research suggests that coenzyme Q10 does not improve objective measures of CHF, including left ventricular ejection fraction (LVEF), cardiac output, or NYHA classification (5090,5248,6037,6038,43904,43932,96542,43932,97902). It is possible that the benefit of coenzyme Q10 depends on the dose and duration, the severity of CHF, and the specific conventional therapies taken concurrently (43973). A meta-analysis of 11 small, low-quality studies concludes that coenzyme Q10 probably reduces risk of all-cause and cardiovascular mortality, and of hospital admission for CHF, but data on improvement in LVEF or exercise capacity and the risk for myocardial infarction and stroke are inconclusive. However, the included studies used a range of coenzyme Q10 doses, varying concurrent therapy, short follow-up periods, and variable measures of treatment effect (108954).

In patients with CHF with preserved ejection fraction (HFpEF) and a LVEF of 50% or greater, taking coenzyme Q10 600 mg daily for 12 weeks reduces B-type natriuretic peptide levels and improves Kansas City Cardiomyopathy Questionnaire (KCCQ) scores, level of vigor, and LVEF when compared with placebo (108959).

Diabetic neuropathy. When taken alone or as add-on treatment with pregabalin, most research suggests that oral coenzyme Q10 reduces symptoms in patients with diabetes and neuropathy.

Details: Clinical research shows that taking coenzyme Q10 400 mg orally daily for 12 weeks significantly improves nerve conduction and symptoms of neuropathic pain when compared with placebo in diabetic patients with polyneuropathy (44217). The beneficial effects of coenzyme Q10 have also been investigated as an add-on treatment in patients taking pregabalin 150 mg daily. Clinical research shows that taking coenzyme Q10 100 mg three times daily for 8 weeks reduces pain severity and sleep interference due to pain when compared with placebo. The proportion of patients taking coenzyme Q10 with a decline in pain of at least 50% was 47%, compared with 27% of those taking placebo. Despite these findings, there was no difference in patient global improvement (109391).

However, some research disagrees. One clinical trial shows that taking coenzyme Q10 (Health Burst) 200 mg daily for 12 weeks does not affect neuropathic symptoms, including pain, sensations, and strength, when compared with placebo (109386).

Fibromyalgia. Oral coenzyme Q10 seems to improve both physical and psychological symptoms of this condition.

Details: Clinical research in women with fibromyalgia shows that taking coenzyme Q10 300-400 mg orally daily for 40 days to 3 months improves pain by 24% to 56%, fatigue by 22% to 47%, sleep disturbances by 33%, morning tiredness by 56%, and tender points by 44% when compared with placebo. Patients also experience an improvement in psychological symptoms, including depression and anxiety (89416,97912,97913).

Ischemia-reperfusion injury. Oral or intravenous coenzyme Q10 may help reduce hypoxic damage during cardiac bypass or vascular surgery.

Details: Clinical research shows that taking coenzyme Q10, 150-300 mg orally daily in up to 3 divided doses for 1-2 weeks before cardiac bypass or vascular surgery, or 5 mg/kg IV two hours prior to surgery, reduces hypoxic damage during the surgery (11902,11903,44031,44294). However, coenzyme Q10 has no effect on cardiac function or troponin levels (11904,44292).

Migraine headache. The American Academy of Neurology considers oral coenzyme Q10 to be possibly effective for migraine prevention in adults. Its benefit in children is unclear.

Details: Two small open-label, non-randomized clinical trials in adults show that taking coenzyme Q10 100-150 mg daily decreases the frequency of headaches by up to 50% when compared with baseline or control, although it can take up to 3 months to see benefit (8135,95608). Higher quality research suggests a smaller benefit. A meta-analysis of small randomized controlled trials in adults shows that taking coenzyme Q10 alone or with other supplements reduces migraine attacks by 1.5 times per month and reduces duration of migraines by about 12 minutes when compared with control (105070).

In children and adolescents, some clinical research shows that taking coenzyme Q10 orally, as 100 mg daily or 1-3 mg/kg daily, for 12-16 weeks does not improve headache frequency, severity, or duration when compared with placebo. However, it may reduce migraine frequency in children with low coenzyme Q10 levels (15256,44197). However, another clinical study shows that taking coenzyme Q10 daily is less effective than amitriptyline after one month, but as effective after 3 months, for improving headache frequency, severity, or duration, as well as quality of life. In this study, the dose of coenzyme Q10 was based on weight; 30 mg daily for children weighing less than 30 kg and 60 mg daily for children weighing at least 30 kg (109388).

Multiple sclerosis (MS). Oral coenzyme Q10 seems to reduce fatigue and depression associated with MS.

Details: Clinical research shows that taking coenzyme Q10 500 mg orally daily for 3 months reduces fatigue and depression in patients with MS when compared with placebo (96539).

Muscular dystrophy. Oral coenzyme Q10 seems to improve physical performance in patients with muscular dystrophy of various forms.

Details: Two small clinical studies show that taking coenzyme Q10 orally 100 mg daily for 3 months seems to improve physical performance when compared with placebo in some patients with various muscular dystrophies (2127).

Myocardial infarction (MI). Oral coenzyme Q10 seems to reduce cardiac events and improve survival in patients who have had an MI. It is unclear if coenzyme Q10 improves survival in patients after cardiac arrest.

Details: One small clinical study in patients with acute MI shows that starting coenzyme Q10 60 mg twice daily within 72 hours of the MI appears to significantly reduce the risk of cardiac events, including non-fatal MI and cardiac death, by 52% when administered for 28 days and by 45% when administered for up to one year (10152,44330). Also, a

small clinical study in patients with recent MI who received cardiopulmonary resuscitation, shows that administering a 250 mg loading dose of coenzyme Q10 solution followed by 150 mg three times daily through a nasogastric tube for 5 days improves the 3-month survival rate by 134% when compared with placebo (43935). However, another clinical study in a similar patient population conducted to replicate these results shows that administering coenzyme Q10 300 mg in 50 mL of Ensure every 12 hours for 7 days does not improve in-hospital mortality or neurological outcomes when compared with placebo (105068).

Peyronie disease. Coenzyme Q10 taken orally may reduce Peyronie disease severity.

Details: Clinical research shows that, in patients with early chronic Peyronie disease, taking coenzyme Q10 (Kaneka Nutrients, Osaka) 300 mg orally daily for 24 weeks reduces new plaque formation and plaque size and improves erectile function when compared with placebo. Additionally, disease progression is slowed in about 76% of patients (44180).

POSSIBLY INEFFECTIVE

Alzheimer disease. Coenzyme Q10 appears to be ineffective for improving cognition.

Details: One clinical study shows that taking coenzyme Q10 1200 mg orally daily for 16 weeks does not improve cognition scores when compared with placebo in patients with Alzheimer disease (19206).

Amyotrophic lateral sclerosis (ALS, Lou Gehrig's disease). Oral coenzyme Q10 does not attenuate functional decline in ALS patients.

Details: Clinical research shows that taking coenzyme Q10 2700 mg orally daily for 9 months does not significantly attenuate a decline in ALS functioning scores when compared with placebo (44131). Higher doses, up to 3000 mg daily, have been tolerated by patients with ALS for 5 months, although the effect on ALS functioning at this dose is not known (43955).

Chemotherapy-related fatigue. Oral coenzyme Q10 does not seem to help with fatigue due to chemotherapy.

Details: Clinical research shows that taking coenzyme Q10 100 mg orally three times daily for 24 weeks does not reduce chemotherapy-related fatigue or improve quality of life when compared with placebo in breast cancer patients undergoing chemotherapy with or without radiation (89420).

Diabetes. Most clinical research does not show any benefit with oral coenzyme Q10 in patients with type 1 or type 2 diabetes. However, some research suggests a possible benefit on insulin resistance.

Details: Although a recent meta-analysis and some individual clinical research shows that coenzyme Q10 modestly reduces fasting glucose levels and glycated hemoglobin (HbA1c) in patients with type 1 or type 2 diabetes, most clinical research shows that coenzyme Q10 has no clinically meaningful effect on these parameters (456,492,2126,9890,96544,97911,97918,99636,11877,17704,44023,103778,109389). However, a recent meta-analysis in patients with type 1 or type 2 diabetes shows that improvements in insulin resistance may be clinically meaningful when compared with placebo (109389). In people with type 2 diabetes and nephropathy requiring hemodialysis, coenzyme Q10 120 mg orally daily for 12 weeks does not improve blood glucose levels, HbA1c, or lipid levels when compared with placebo, although it is associated with a decrease in serum insulin levels and insulin resistance (99636).

Parkinson disease. Most clinical research does not show any benefit with the use of oral coenzyme Q10 in patients with Parkinson disease.

Details: While some conflicting evidence exists (8938,15255), a large clinical trial and a meta-analysis of 8 small clinical studies in patients with Parkinson disease show that taking coenzyme Q10 300-2400 mg daily for up to 2 years does not improve Parkinson disease symptoms at any stage of the disease, or slow progression of the disease, when compared with placebo (89421,95610). In addition, a clinical study in patients with mid-stage Parkinson disease shows that taking a specific nanoparticulate coenzyme Q10 supplement (Nanoquinon, MSE Pharmazeutilka) 100 mg orally three times daily does not reduce symptoms when compared with placebo (15395).

Post-polio syndrome. Muscle function in people with post-polio syndrome is not improved by oral coenzyme Q10.

Details: Clinical research shows that taking coenzyme Q10 100 mg twice daily for 12 weeks does not improve muscle strength when compared with baseline, nor does it improve muscle function or muscle endurance when compared with placebo, in patients with post-polio syndrome (44054). Other clinical research shows that taking coenzyme Q10 100 mg daily for 60 days does not improve levels of fatigue when compared with placebo in patients with post-polio syndrome (97917).

LIKELY INEFFECTIVE

Athletic performance. There is some evidence that exercise can deplete coenzyme Q10 and that supplementation will prevent this depletion. However, there is no evidence that taking coenzyme Q10 is beneficial.

Details: Clinical research shows that taking coenzyme Q10 orally does not improve aerobic or anaerobic power or perceived exertion in athletes and non-athletes (2109,2110,8911,44122,44227). While some evidence suggests coenzyme Q10 slightly improves tolerance to higher workloads, more research is needed to tell if coenzyme Q10 is effective for this purpose (8911). One clinical study shows that taking coenzyme Q10 300 mg orally daily for 8 days reduces exercise-induced fatigue when compared with placebo (44006); other research shows that doses of 100-200 mg do not have this effect (44122,44233,44299). Taking the ubiquinol form of coenzyme Q10 200 mg orally daily for one month prevents exercise-induced coenzyme Q10 depletion and decreases levels of reactive oxygen species in blood mononuclear cells in young male athletes performing an intense long-distance run. However, it does not affect physical performance or markers of muscle damage (99429).

Huntington disease. The ubiquinol form of coenzyme Q10 does not seem to improve function in people with this condition.

Details: Ubiquinol, a reduced form of coenzyme Q10, has been evaluated for use in Huntington disease (11873). However, a large, high-quality study shows that taking coenzyme Q10 2.4 grams orally daily for up to 5 years does not slow the progression or functional decline in patients with Huntington disease (96538). Other studies using doses up to 600 mg daily also show no benefit (1357,8940).

INSUFFICIENT RELIABLE EVIDENCE to RATE

Age-related macular degeneration (AMD). Oral coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: Clinical research in adults with early AMD shows that taking a specific combination product (Phototrop, Sigma-tau Health Science Ltd.) containing coenzyme Q10 10 mg, acetyl-L-carnitine 100 mg, and omega-3 fatty acids 530 mg orally daily for 12 months seems to reduce the percentage of patients who experience deterioration of vision by about 50%, and the percentage who have reduced light sensitivity by about 39%, when compared with placebo (43946). The effects of coenzyme Q10 alone are unclear.

Aging. Although there has been interest in using oral coenzyme Q10 for aging, there is insufficient reliable information about the clinical effects of coenzyme Q10 for this purpose.

Angina. There is some limited clinical evidence that coenzyme Q10 can improve exercise tolerance and symptoms in people with this condition.

Details: Preliminary clinical research shows that taking coenzyme Q10 50 mg three times daily orally for 4 weeks improves exercise tolerance in people with angina by about 18% (2121). Also, taking 60 mg once daily for 4 weeks improves heart failure scores, angina symptoms, and heart volume when compared to baseline in patients with stable angina (44336). The validity of these findings is limited by the lack of a comparator group.

Anthracycline cardiotoxicity. Evidence on the use of coenzyme Q10 to protect against anthracycline cardiotoxicity in adults and children is conflicting.

Details: Preliminary clinical research in children aged 3-12 years shows that taking coenzyme Q10 orally 100 mg twice daily might protect against anthracycline cardiotoxicity (44279). However, evidence from larger clinical trials evaluating patients aged 16-77 years is conflicting. Results from one of these studies suggests that intravenous administration of coenzyme Q10 1 mg/kg daily the day before, the day of, and for 2 days after anthracycline treatment does not protect against cardiotoxicity (44267). Differences between the studies may be due to methodological problems, or differences in doses, route of administration, and age of participants.

Asthma. Oral coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: Preliminary clinical research shows that taking a combination of coenzyme Q10 (Q-Gel, Tishcon Corporation) 120 mg, vitamin E 400 mg, and vitamin C 250 mg orally daily in addition to conventional anti-asthmatic therapy for 16 weeks might reduce the dosage of corticosteroids required by patients with mild to moderate asthma. However, it does not appear to improve lung function any more than standard therapy alone (43969).

Attention deficit-hyperactivity disorder (ADHD). It is unclear if oral coenzyme Q10 is beneficial in children with ADHD.

Details: A small clinical study in children aged 6-16 years with ADHD who are unresponsive to atomoxetine therapy shows that taking coenzyme Q10 1-3 mg/kg with atomoxetine 0.5-1.8 mg/kg daily for 6 months improves parent-rated symptoms of ADHD, particularly hyperactivity-related symptoms, when compared with placebo plus atomoxetine (107449).

Autism spectrum disorder. It is unclear if the ubiquinol form of coenzyme Q10 taken orally is beneficial in children aged 3-6 years with this condition.

Details: A small clinical study in children aged 3-6 years suggests that taking the reduced form of coenzyme Q10, ubiquinol (Li-QH, Tishcon Corporation), 50 mg orally once daily for one week followed by 50 mg twice daily for 11 weeks, improves symptoms of autism spectrum disorder, including communication with parents, ability to play with friends, verbal communication, sleeping, food rejection, aggressiveness, and self-harm, when compared with baseline, per parent assessment (89419). The validity of these findings is limited by the small study size, the use of parent assessment, and the lack of a comparator group.

Bipolar disorder. It is unclear if oral coenzyme Q10 is beneficial for bipolar disorder in older adults.

Details: Preliminary clinical research in people 55 years of age or older with bipolar disorder shows that taking coenzyme Q10 800 mg orally daily for 4 weeks improves symptoms of depression when compared with baseline (95606). The validity of this finding is limited by the lack of a comparator group.

Breast cancer. Low coenzyme Q10 levels may be associated with an increased risk of breast cancer. The benefit of coenzyme Q10 supplementation is unclear.

Details: Population research in Chinese women has found that low plasma coenzyme Q10 levels are associated with an increased risk of breast cancer (44194).

Cancer. Low coenzyme Q10 levels may increase the risk of cancer development and progression.

Details: Population research has found that low coenzyme Q10 levels are associated with increased risk of metastatic melanoma (43959). Preliminary clinical research suggests that taking coenzyme Q10 150 mg twice daily along with vitamins A, C, and E, selenomethionine, beta-carotene, and folic acid extends survival time by 40% when compared with predicted survival in patients with end-stage cancer from various different primary sites (44159). It is unclear if this effect is due to coenzyme Q10, other ingredients, or the combination.

Cardiovascular disease (CVD). It is unclear whether oral coenzyme Q10 has a role in preventing complications from CVD.

Details: Preliminary clinical research shows that taking coenzyme Q10 300 mg 2 hours prior to an elective percutaneous coronary intervention does not reduce periprocedural myocardial injury or prevent major adverse cardiac events during one month of follow-up (96543). Other clinical research shows that taking a combination of coenzyme Q10 (Bio-Quinon, Pharma Nord) 100 mg twice daily plus organic selenium yeast tablets (SelenoPrecise, Pharma Nord) 200 mcg daily for 4-5 years reduces the risk of death from CVD by 7% when compared with placebo in elderly people living in Sweden (92904). This benefit appears to persist even after supplement discontinuation, with an 18% reduction at 10 years and an 11% reduction at 12 years (96546,97466,97906). In this same trial, post-hoc subgroup analyses in patients with elevated baseline D-dimer levels and/or hypertension or ischemic heart disease shows that taking this combination reduces cardiovascular mortality when compared with placebo (105874). It is unclear if these benefits are due to coenzyme Q10, selenium, or the combination.

Cataracts. It is unclear if coenzyme Q10-containing eye drops are beneficial in patients undergoing cataract surgery.

Details: Clinical research suggests that administering an ophthalmic solution containing coenzyme Q10 and vitamin E D-alpha-tocopheryl polyethylene glycol 1000 succinate twice daily for 9 months increases the speed of nerve regeneration when compared with saline solution in post-cataract surgery patients (44228).

Cerebellar ataxia. It is unclear if coenzyme Q10 is beneficial for this condition.

Details: Preliminary clinical research in patients with cerebellar ataxia shows that coenzyme Q10 30 mg/kg daily for 2 years improves ataxia scores by 48%, posture scores by 63%, and kinetic function scores by 37% when compared with baseline, but only in patients who are coenzyme Q10 deficient (44177). The validity of these findings is limited by the lack of a comparator group.

Chronic fatigue syndrome (CFS). Oral coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: A small clinical study in patients with CFS shows that taking coenzyme Q10 200 mg plus NADH 20 mg daily for 8 weeks does not improve measures of fatigue, sleep, or quality of life when compared with placebo (107448).

Chronic obstructive pulmonary disease (COPD). It is unclear if coenzyme Q10 is beneficial for improving exercise tolerance in people with COPD.

Details: Preliminary clinical research suggests that taking coenzyme Q10 90 mg daily for 8 weeks reduces lactate production during anaerobic exercise in people with COPD, but does not improve oxygen consumption or exercise performance, when compared with baseline (44293). The validity of these findings is limited by the lack of a comparator group.

Cocaine dependence. Oral coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: One clinical study in patients with cocaine dependence shows that taking a combination of coenzyme Q10 200 mg and L-carnitine 500 mg orally daily for 8 weeks does not reduce cocaine use when compared with placebo, as measured by urine benzoylecgonine levels and self-reported usage (43940).

Coronavirus disease 2019 (COVID-19). It is unclear if oral coenzyme Q10 is beneficial for patients with persistent symptoms after COVID-19 infection.

Details: Clinical research in individuals with previous confirmed COVID-19 infection and continued symptoms lasting more than 12 weeks shows that taking coenzyme Q10 (Pharma Nord) 100 mg five times daily for 6 weeks does not reduce the number or severity of symptoms when compared with placebo. The most common symptoms were concentration problems, mental and physical fatigue, headache, and/or muscle weakness (109392).

Critical illness (trauma). It is unclear if oral coenzyme Q10 is beneficial in patients hospitalized due to acute trauma.

Details: Preliminary clinical research in patients who are mechanically ventilated due to acute trauma and have low baseline coenzyme Q10 plasma levels shows that taking sublingual coenzyme Q10 (Nutri Q10, Nutri Century) 400 mg daily for 7 days reduces the duration of intensive care stay, mechanical ventilation, and hospitalization by 4 days, 2 days, and 6 days, respectively, when compared with placebo. Patients taking coenzyme Q10 also demonstrated larger improvements in organ function scores and coma scores than those taking placebo (105875).

Cyclic vomiting syndrome (CVS). Limited evidence suggests oral coenzyme Q10 may reduce episodes of CVS.

Details: Preliminary clinical research shows that taking coenzyme Q10 10 mg/kg orally twice daily is comparable to amitriptyline 0.5-1 mg/kg/day for reducing the number of CVS episodes in both children and adults (17703).

Diabetic nephropathy. Although there has been interest in using oral coenzyme Q10 for diabetic nephropathy, there is insufficient reliable information about the clinical effects of coenzyme Q10 for this purpose.

Dilated cardiomyopathy. Very small clinical studies suggest that children and adolescents with dilated cardiomyopathy may benefit from oral coenzyme Q10.

Details: Preliminary clinical research in children with dilated cardiomyopathy suggests that taking coenzyme Q10 3-10 mg/kg daily, divided into 2-3 doses for up to 9 months, improves ejection fraction and New York Heart Association (NYHA) classification when compared to baseline (12199,13223). Also, in people under 20 years of age, taking a specific oral liquid formulation of coenzyme Q10 (QuinoMit Q10 Fluid, MSE Pharmazeutika GmbH), 10 mg/kg daily for 24 weeks produces a small increase in ejection fraction and improves NYHA class from II to I in 30% of patients (99427). The validity of these findings is limited by the lack of comparator groups.

Dry eye. Ophthalmic coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: Clinical research has evaluated the use of a specific eye drop (VisuXL, Visufarma) containing coenzyme Q10 and cross-linked hyaluronic acid, in a 1:1 ratio with alpha-tocopherol polyethylene glycol succinate. One study in menopausal women receiving antidepressants shows that placing 1 drop in each eye twice daily for 8 weeks reduces dry eye severity by 17% and improves tear break-up time when compared to 5 drops daily of carmellose eye drops (104553). In addition, another study in adults with mild to moderate dry eye shows that placing 1 drop in each eye four times daily for 12 weeks reduces dry eye severity by 14% and decreases some laboratory markers of dry eye when compared to hyaluronic acid alone. Both groups demonstrated similar improvement in meibomian gland function and tear break-up time (97909). The effect of coenzyme Q10 when used alone is unclear.

Dry mouth. It is unclear if oral ubiquinol or ubiquinone improves salivary secretion.

Details: Preliminary clinical research suggests that taking coenzyme Q10, as the reduced ubiquinol form or as the oxidized ubiquinone form, 100 mg orally daily for one month, improves salivary secretion by 72% to 82% when compared with baseline in patients with dry mouth (44191). The validity of these findings is limited by the lack of a comparator group.

Erectile dysfunction (ED). It is unclear if oral coenzyme Q10 is beneficial in patients with ED.

Details: A small, open-label study in patients with hypertension and complaints of ED shows that taking coenzyme Q10 200 mg daily for 3 months along with current antihypertensive therapy does not improve symptoms of ED when compared with antihypertensive therapy alone (107447).

Fatigue. It is unclear if oral coenzyme Q10 is beneficial for reducing fatigue.

Details: A meta-analysis of low- to moderate-quality clinical research in mixed populations shows that taking coenzyme Q10 modestly reduces feelings of fatigue when compared with placebo. This improvement was consistent between groups of healthy individuals and individuals with fatigue related to disease. However, a sub-group analysis shows that benefits are limited to studies in which coenzyme Q10 was studied as a single ingredient. Doses of coenzyme Q10 ranged from 60 mg to 500 mg daily for 4-12 weeks with treatment effects appearing to be both dose- and duration-dependent (109387).

Friedreich ataxia. Oral coenzyme Q10 has been evaluated in combination with vitamin E; its effect when used alone is unclear.

Details: Preliminary clinical research shows that taking coenzyme Q10 (Bio-Quinon Q10, Pharma Nord) 200 mg orally twice daily plus vitamin E (Bio-E-Vitamin, Pharma Nord) 1050 IU twice daily for 47 months improves measures of cardiovascular function by 20% when compared with baseline. However, it does not improve posture or gait, or prevent deterioration of posture, gait, speech, or eye function, when compared with baseline (43943,44064). It is unclear if these benefits are due to coenzyme Q10, vitamin E, or the combination. Also, the validity of these findings is limited by the lack of a comparator group.

Hearing loss. There is conflicting evidence regarding the effects of oral coenzyme Q10 on hearing loss of various etiologies.

Details: Some clinical research shows that taking coenzyme Q10 terclatrate (Qter), a water-soluble formulation of coenzyme Q10, 160 mg orally daily for 30 days improves hearing thresholds when compared to baseline in patients with age-related hearing loss (44171,44184). However, taking coenzyme Q10 terclatrate 200 mg daily for 7 days does not significantly improve hearing thresholds when compared with placebo in patients with noise-induced hearing loss (44143). Also, combining coenzyme Q10 with conventional steroid therapy for 2 weeks does not improve hearing when compared with steroid therapy alone in patients with sudden sensorineural hearing loss (44185).

Hepatitis C. It is unclear if oral coenzyme Q10 is beneficial in patients with this condition.

Details: Clinical research shows that taking coenzyme Q10 up to 80 mg orally daily for 28 days does not reduce serum liver enzymes when compared with placebo in patients with chronic hepatitis C who are unresponsive to conventional treatment (44172).

Hyperlipidemia. There is conflicting evidence regarding the effects of coenzyme Q10 on cholesterol levels in adults. However, any changes are unlikely to be clinically meaningful.

Details: A meta-analysis of 50 moderate-quality clinical trials shows that taking coenzyme Q10 has small beneficial effects on levels of total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides when compared with a control, usually placebo (109394). However, whether coenzyme Q10 produces clinically meaningful changes is unclear. In a subgroup of patients with dyslipidemia, coenzyme Q10 does not seem to have significant beneficial effects on total cholesterol (109394). Also, previous individual clinical trials and meta-analyses in specific populations, including studies in which lipoprotein A was measured, as well as populations with diabetes, coronary artery disease, and others, have not shown beneficial effects on plasma lipids (17704,44187,96545,97918,109394).

The effect of coenzyme Q10 on lipoprotein A has also been investigated. Individual studies and a meta-analysis show that taking coenzyme Q10 slightly reduces plasma levels of lipoprotein A when compared with placebo (17704,44187,96545). Most studies have used doses of 100-500 mg daily for 4-24 weeks (17704,44187,96545,96547,97910,109394).

Hypertension. Most research suggests that oral coenzyme Q10 may reduce systolic blood pressure (SBP), but not diastolic blood pressure (DBP).

Details: Most clinical research shows that taking coenzyme Q10 100-900 mg orally daily in divided doses, either alone or with conventional medications, for up to 12 weeks significantly lowers SBP (2122,3365,9890,17702,17650,17651,44343,109393). One meta-analysis of moderate quality clinical research in patients with cardiometabolic disorders shows that supplementation with coenzyme Q10, especially 100-200 mg daily for at least 12 weeks, reduces SBP by 5 mmHg (109393). However, some studies show conflicting results. Most clinical research shows that coenzyme Q10 supplementation does not reduce DBP (8907,96541,109393). Also, a meta-analysis of two clinical studies (17651,44211) shows that taking coenzyme Q10 100-200 mg orally daily has no significant effect on blood pressure when compared with placebo (95607). Conflicting results may be due to differences in the severity of hypertension at baseline, adjustments made to conventional medications during studies, and the presence of a variety of concomitant conditions. Some data also suggest that effects may be greater in people with low baseline levels of coenzyme Q10 (2122,17650,17651).

Hypertrophic cardiomyopathy. It is unclear if oral coenzyme Q10 is beneficial for this condition.

Details: A very small clinical study of 7 patients suggests that taking coenzyme Q10 (Vitaline) 120-240 mg orally daily with the goal of raising blood levels above 2 mcg/mL, might improve symptoms of hypertrophic cardiomyopathy, including dyspnea and fatigue, and decrease cardiac wall thickness, when compared to baseline (11031). The validity of these findings is limited by the small size of the study and the lack of a comparator group.

Kidney failure. Oral coenzyme Q10 has been reported to improve renal function in people with kidney failure, but not in those with less severe kidney disease.

Details: Preliminary clinical research in patients with kidney failure shows that taking coenzyme Q10 180 mg orally daily for 28 days improves blood urea nitrogen, serum creatinine, and creatinine clearance when compared with placebo (44347). However, other clinical research in patients with less severe kidney disease shows that taking

coenzyme Q10 200 mg daily for 8 weeks does not significantly improve kidney function parameters, including urinary albumin, total protein, or glomerular filtration rate, when compared with placebo (44128).

Infertility. It is unclear if oral coenzyme Q10 helps women undergoing assisted reproductive technology (ART) treatment.

Details: A meta-analysis of 5 small clinical studies in infertile women undergoing ART treatment shows that although coenzyme Q10 increases the odds of clinical pregnancy more than 2-fold, it does not seem to affect the rate of live births or miscarriages when compared with placebo or no treatment (103780).

Male Infertility. Oral coenzyme Q10 may improve some measures of sperm function in males with infertility, but there is no convincing evidence that it can increase pregnancy rates.

Details: One small clinical study in males with idiopathic asthenozoospermia shows that coenzyme Q10 200 mg orally daily for 6 months improves sperm motility when compared with baseline (12169). The validity of this finding is limited by the lack of a comparator group. Coenzyme Q10 has also been studied in males with idiopathic oligoasthenoteratozoospermia, but results are conflicting. Studies have used coenzyme Q10 or its reduced form, ubiquinol, in doses of 200-300 mg orally daily for 26 weeks. Sperm density and motility are increased when compared with placebo, but pregnancy rates do not seem to improve (17413,89422). Three studies have used coenzyme Q10 200-400 mg orally daily for 12-26 weeks, with two reporting increased sperm concentration and motility when compared to baseline, but the other finding no improvements when compared with placebo (44190,102008,107444).

Coenzyme Q10 has also been investigated in combination with vitamin E. In one preliminary clinical trial, taking coenzyme Q10 10 mg three times daily with vitamin E 100 mg daily for 3 months modestly increases levels of testosterone and improves progressive sperm motility and morphology when compared with baseline. However, taking an L-carnitine nutrient complex 15 grams twice daily was more effective for increasing testosterone and for improving sperm parameters (109390).

Maternally inherited diabetes mellitus and deafness (MIDD). It is unclear if oral coenzyme Q10 is beneficial for MIDD.

Details: One small clinical study shows that taking coenzyme Q10 150 mg orally daily for 3 years might prevent progressive insulin secretory defect, exercise intolerance, and hearing loss when compared with baseline in people with this rare form of diabetes (2125).

Metabolic syndrome. It is unclear if oral coenzyme Q10 is beneficial in patients with metabolic syndrome.

Details: A small clinical study in patients with metabolic syndrome receiving healthy dietary recommendations shows that taking coenzyme Q10 60 mg daily for 12 weeks does not have beneficial effects on blood glucose, cholesterol, waist circumference, or blood pressure when compared with placebo (109284).

Myocarditis. It is unclear if oral coenzyme Q10 is beneficial in patients with acute viral myocarditis.

Details: A small observational study in Chinese patients with acute viral myocarditis has found that taking coenzyme Q10 10 mg and trimetazidine 20 mg three times daily for 2 weeks, along with standard care, is associated with higher rates of resolution and improved quality of life when compared with coenzyme Q10 plus standard care alone (107443). While coenzyme Q10 alone appeared to improve symptoms and markers of cardiac function when compared to baseline in some patients, the validity of these findings is limited by a lack of placebo control.

Nonalcoholic fatty liver disease (NAFLD). Coenzyme Q10 may reduce liver enzymes and the severity of NAFLD.

Details: Preliminary clinical research in adults with NAFLD shows that taking coenzyme Q10 100 mg orally daily for 12 weeks reduces the clinical grade of NAFLD and decreases plasma levels of liver enzymes when compared with placebo (97907).

Obesity. Oral coenzyme Q10 does not seem to improve weight loss in adults.

Details: A meta-analysis of small, highly heterogeneous clinical trials shows that taking coenzyme Q10 100-300 mg daily for up to 24 weeks does not reduce weight or body mass index when compared with placebo. However, the included studies were not designed to assess for weight loss and involved patients with type 2 diabetes, metabolic syndrome, kidney disease, liver disease, rheumatoid arthritis, and other conditions (105067).

Periodontitis. Data on the effects of oral or topical coenzyme Q10 are conflicting. It is unclear if coenzyme Q10 is beneficial for periodontitis.

Details: Some very small, low-quality studies suggest that taking coenzyme Q10 orally, 50 mg daily for 3 weeks, might be beneficial for periodontitis (8917,8918). Preliminary research with topical coenzyme Q10 suggests it is ineffective (2107,2108). However, a meta-analysis of 11 clinical trials evaluating coenzyme Q10 topical gel shows reductions in plaque index, bleeding index, pocket index, clinical attachment level, and gingival index when compared with placebo gel or scaling and root planing alone. The greatest effects are seen when coenzyme Q10 gel is applied directly into the periodontal pocket daily for at least six weeks in combination with scaling and root planing (108958). The validity of these findings is limited by a high risk of bias and the overall low quality of the included studies.

Polycystic ovary syndrome (PCOS). Most clinical studies suggest that oral coenzyme Q10 modestly improves symptoms in patients with PCOS.

Details: A meta-analysis of clinical trials in patients with PCOS shows that taking coenzyme Q10 modestly improves measures of glycemic response, as well as plasma lipids and some sex hormones, when compared with placebo (109384). However, any changes are small and the clinical relevance is unclear. Also, although nine studies were included in the review, the number of studies included for each endpoint was much lower. Most clinical studies included in the analysis used 100-200 mg daily for 8-12 weeks (107446,109384). An additional small clinical study also shows that taking coenzyme Q10 (Nature Made) 100 mg orally daily for 12 weeks reduces fasting plasma glucose, insulin, and total cholesterol and improves insulin sensitivity when compared with placebo. This study also found that taking coenzyme Q10 reduces alopecia by about 33% and acne by 48% when compared with placebo (97914). Another small clinical study shows that taking coenzyme Q10 100 mg daily for 12 weeks reduces depression, anxiety, and hirsutism when compared with placebo (107446).

Prader-Willi syndrome (PWS). It is unclear if oral coenzyme Q10 is beneficial in patients with PWS.

Details: Preliminary clinical research in children with Prader-Willi syndrome shows that taking coenzyme Q10 2.5 mg/kg orally daily for one year improves psychomotor development similarly to growth hormone therapy, although this might reflect natural changes in the condition occurring over time (44005).

Pre-eclampsia. Taking coenzyme Q10 orally seems to reduce the rate of pre-eclampsia in women at risk for the condition.

Details: Clinical research shows that taking coenzyme Q10 (Q-absorb, Jarrow Formulas) 100 mg orally twice daily during pregnancy, starting at 20 weeks gestation and continuing until term, reduces the rate of pre-eclampsia by about 44% when compared with placebo in women at risk for developing this condition (17201).

Schizophrenia. It is unclear if oral coenzyme Q10 improves symptoms in patients with schizophrenia or schizoaffective disorder.

Details: A small clinical study in patients with schizophrenia or schizoaffective disorder shows that taking coenzyme Q10 300 mg daily for 6 months does not improve attention, working memory, negative symptoms, mood disorders, or quality of life when compared with placebo (105069). This finding is limited by insufficient power and poor protocol adherence, with only 61% of the participants taking at least 90% of the study treatment.

Sepsis. There is no strong evidence that coenzyme Q10 is helpful in the management of sepsis or septic shock.

Details: Patients with septic shock have been shown to have low levels of coenzyme Q10, but the effects of supplementation are unclear. Some preliminary clinical research shows that taking coenzyme Q10 100 mg orally twice daily for 7 days reduces the risk of in-hospital mortality by 69% and improves markers of inflammation, but does not reduce length of ICU stay, when compared with conventional treatment alone (102548). However, other preliminary research shows that taking coenzyme Q10 as ubiquinol 200 mg twice daily for 7 days has no effect on inflammatory or vascular endothelial biomarkers, mortality, or length of stay when compared with placebo (96540). Both studies were small and likely underpowered to detect a meaningful change in clinical outcomes.

Statin-induced myalgia. There is conflicting evidence regarding the effects of oral coenzyme Q10 on statin-associated muscular adverse effects, such as myalgia.

Details: Some clinical research shows that taking coenzyme Q10 (Q-Sorb softgel, Nature's Bounty) 100 mg orally daily for 30 days reduces pain intensity when compared with baseline or vitamin E control in patients with statin-induced myalgia (16008,44345). Other clinical research shows that taking coenzyme Q10 (MGC Company) 50 mg orally twice daily for 30 days reduces muscle pain and pain interference with daily activities by 30% to 40% when compared with placebo (95604). One small study in adults with statin-induced myalgia shows that taking liquid coenzyme Q10 (Q-Factor, Giellepi S.p.A) 100 mg orally daily for 3 months modestly reduces pain scores, but not plasma creatine kinase (CK) levels, when compared with placebo (102007). Other clinical research shows that taking coenzyme Q10 (Bio-Quinon, Pharma Nord) 100 mg twice daily, with or without selenium, for 3 months, reduces muscle pain and weakness, cramps, and tiredness when compared with placebo (92909).

However, not all studies have shown benefit. Meta-analyses of several small randomized controlled trials show that taking coenzyme Q10 100-600 mg daily for 1-3 months does not improve muscle pain, statin tolerability, or plasma CK activity in patients with statin-induced myalgia when compared with placebo (95602,103781,106050). However, the validity of these results is limited by small population size and high heterogeneity. Other clinical research shows that taking coenzyme Q10 60 mg twice daily for 3 months does not improve muscle pain when compared with placebo (44218). Also, taking coenzyme Q10 (Q-Gel, Tishcon Corporation) 200 mg daily for 12 weeks does not affect myalgia scores when compared with placebo in patients taking simvastatin (44346). Additionally, taking high doses of coenzyme Q10 600 mg daily for 8 weeks does not affect the incidence, severity, or time to onset of statin-induced myalgia when compared with placebo in patients taking simvastatin (95603).

Reasons for these conflicting findings are not entirely clear. The inconsistent results do not appear to be related to the dose of coenzyme Q10 or plasma CK levels. About 50% of patients who experience statin-induced myalgia will tolerate a statin re-challenge with a lower or equivalent dose of the same or alternative statin after a statin-free interval, which is a higher response rate than seen in currently available studies with the use of coenzyme Q10. Taking coenzyme Q10 for 30 days may be a reasonable option if other attempts to improve tolerance have failed. If a significant improvement in pain related to statin use is not seen after 30 days of taking coenzyme Q10, it is unlikely to be beneficial (96548).

Statin-induced myopathy. There is conflicting evidence regarding the effects of coenzyme Q10 on statin-associated muscular adverse effects, including myopathy.

Details: Clinical research shows that taking coenzyme Q10 (Bio-Quinon, Pharma Nord) 100 mg orally twice daily, with or without selenium, for 3 months, reduces muscle weakness and pain, cramps, and tiredness when

compared with placebo in patients with statin-induced myopathy due to atorvastatin, fluvastatin, rosuvastatin, or simvastatin (92909). Preliminary clinical research also shows that taking coenzyme Q10 60 mg orally four times daily decreases the rate of dose-limiting statin-induced myopathy in patients taking high-dose lovastatin as an investigational treatment for cancer (11899,11900). However, when coenzyme Q10 (Myoquinon, Pharma Nord,) 400 mg orally daily is used in combination with selenium for 12 weeks, it does not affect atorvastatin-induced myopathy when compared with placebo (92908).

Toxin-induced liver damage. Oral coenzyme Q10 has only been evaluated in combination with other ingredients; its effect when used alone is unclear.

Details: A small clinical study in patients being treated with anti-tuberculosis drugs shows that taking coenzyme Q10 200 mg, acetyl-L-carnitine 250 mg, and alpha-lipoic acid 250 mg twice daily for 2 weeks reduces the risk of drug-induced liver injury by 73% when compared with placebo (107445). It is unclear if these findings are due to coenzyme Q10, other ingredients, or the combination.

Ulcerative colitis. It is unclear if oral coenzyme Q10 is beneficial in patients with ulcerative colitis.

Details: Preliminary clinical research in adults with ulcerative colitis shows that taking oral coenzyme Q10 (Nutri Q10, Nutri Century Company) 100 mg twice daily for 8 weeks modestly improves ulcerative colitis disease activity and quality of life scores when compared with placebo. Taking coenzyme Q10 also reduces systolic and diastolic blood pressure by 4 mmHg and 2 mmHg, respectively, when compared with placebo (106049). The clinical relevance of these changes is unclear.

Wrinkled skin. It is unclear if topical application of coenzyme Q10 cream can reduce wrinkles.

Details: A small clinical study shows that applying a coenzyme Q10 1% cream to the skin twice daily for 5 months reduces objective wrinkle scores when compared to baseline (44082). The validity of this finding is limited by the lack of a comparator group.

More evidence is needed to rate coenzyme Q10 for these uses.

Dosing & Administration

- **Adult**

  Oral:

  Typical doses of coenzyme Q10 range from 60-1000 mg daily for up to 12 weeks, but doses as high as 2400 mg have been used for up to 5 years. To minimize adverse effects, doses above 100 mg daily should be divided throughout the day. See Effectiveness section for condition-specific information.

  Topical:

  Coenzyme Q10 has been used as a 1% cream for up to 5 months. See Effectiveness section for condition-specific information.

  Ophthalmic:

  Coenzyme Q10 has been used in various eye drop formulations in combination with other ingredients for up to 9 months. See Effectiveness section for condition-specific information.

- **Children**

  Oral:

  Coenzyme Q10 has been used in doses of 50-250 mg, or 1-20 mg/kg, daily in divided doses for up to 1 year. See Effectiveness section for condition-specific and age-specific information.

- **Standardization & Formulation**

  Specific formulations of coenzyme Q10 that have been used in clinical research include: Q-Gel (Tishcon Corporation); Kaneka QH ubiquinol (Kaneka Nutrients); Ubimaior 50 (Master Pharma S.r.l., Parma); Kino-Q-10 (Leiras Oy, Turku); Q-absorb Co Q10 100 (Jarrow Formulas); Ultrasome Coenzyme Q10 (Herbamed Ltd.); Bio-Quinon Q10 (Pharma Nord); Sanomit (MSE Pharma); Q-Sorb softgel (Nature's Botany); Coenzyme Q10 (Vitaline Corporation); Nutri Q10 (Nutri Century); and Myoquinon (Pharma Nord).

Interactions with Drugs

ALKYLATING AGENTS

Interaction Rating = **Moderate** Be cautious with this combination.

Severity = Moderate • Occurrence = Possible • Level of Evidence = **D**

Coenzyme Q10 has antioxidant effects. Theoretically, this may reduce the activity of chemotherapy drugs that generate free radicals.

Details

Theoretically, antioxidants such as coenzyme Q10 might protect tumor cells from chemotherapeutic agents that work by inducing oxidative stress, such as alkylating agents (e.g., cyclophosphamide) and radiation therapy (5158,5159). The clinical importance of this interaction is unknown.

ANTIHYPERTENSIVE DRUGS

Interaction Rating = **Minor** Be watchful with this combination.

Severity = Mild • Occurrence = Possible • Level of Evidence = **B**

Theoretically, coenzyme Q10 might have additive effects with antihypertensive drugs.

Details

Some clinical research shows that coenzyme Q10 can significantly lower blood pressure (2122,3365,8907,9890,17702,17650,17651,44343,96541), although other studies have shown conflicting results (17651,44211,95607).

WARFARIN (Coumadin)

Interaction Rating = **Moderate** Be cautious with this combination.

Severity = High • Occurrence = Possible • Level of Evidence = **D**

Coenzyme Q10 is chemically similar to menaquinone and might have vitamin K-like procoagulant effects, which could decrease the effects of warfarin.

Details

Concomitant use of coenzyme Q10 and warfarin might reduce the anticoagulant effects of warfarin (2128,6048,6199). Four cases of decreased warfarin efficacy thought to be due to coenzyme Q10 have been reported (2128,6048,11048). However, there is some preliminary clinical research that suggests coenzyme Q10 might not significantly decrease the effects of warfarin in patients who have a stable INR (11905).

Interactions with Supplements

ACACIA: Mixing coenzyme Q10 with acacia gum increases coenzyme Q10 absorption.

Details

In animal and human pharmacokinetic research, emulsifying coenzyme Q10 in acacia gum increases the absorption of coenzyme Q10 compared to coenzyme Q10 powder alone (44168). Theoretically, this may increase the risk of adverse effects.

BETA-CAROTENE: Taking coenzyme Q10 with beta-carotene can increase beta-carotene levels.

Details

In clinical research, supplementation with coenzyme Q10 increased beta-carotene levels (44330). Theoretically, this may increase the risk of adverse effects.

HERBS AND SUPPLEMENTS WITH HYPOTENSIVE EFFECTS: Coenzyme Q10 can lower blood pressure and may have additive effects with other herbs and supplements that have hypotensive effects.

Details

Coenzyme Q10 can decrease blood pressure (2122,9890,17702,43932,43982). Theoretically, combining coenzyme Q10 with other herbs or supplements with hypotensive effects might increase the risk of hypotension.

OMEGA-3 FATTY ACIDS: Omega-3 fatty acids seem to reduce plasma levels of coenzyme Q10.

Details

In clinical research, combining omega-3 fatty acids with coenzyme Q10 reduced plasma levels of coenzyme Q10 (44128). Theoretically, using coenzyme Q10 in combination with omega-3 fatty acids might reduce the effects of coenzyme Q10.

RED YEAST RICE: Red yeast rice contains an HMG-CoA reductase inhibitor. This constituent may reduce the synthesis and endogenous levels of coenzyme Q10.

Details

Theoretically, since red yeast rice has HMG-CoA reductase inhibitor ("statin") constituents it may reduce synthesis of mevalonic acid, a precursor of coenzyme Q10 (512,3370). This might reduce endogenous coenzyme Q10 levels.

VITAMIN K: Coenzyme Q10 has vitamin K-like activity and may increase its effects.

Details

Coenzyme Q10 is chemically similar to vitamin K2 (menaquinone) and can have vitamin K-like effects, including antagonism of warfarin (2128,6048). Concomitant use of coenzyme Q10 and vitamin K might cause additive effects and increase the risk of clotting in people taking anticoagulants.

Interactions with Conditions

None known.

Interactions with Lab Tests

None known.

Nutrient Depletion

SOME DRUGS CAN AFFECT COENZYME Q10 LEVELS:

ANTHRACYCLINES

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Anthracyclines might alter synthesis and storage of coenzyme Q10, but it is unclear whether coenzyme Q10 supplements are beneficial during anthracycline therapy.

Details

Anthracycline chemotherapeutic agents are thought to inhibit coenzyme Q10 mitochondrial enzymes and the synthesis of coenzyme Q10 in the heart. However, plasma levels of coenzyme Q10 might actually rise immediately after treatment with these drugs, due to myocardial tissue damage resulting in release of coenzyme Q10 into plasma (14412). Preliminary research suggests that coenzyme Q10 might protect against anthracycline cardiotoxicity, possibly through correction of coenzyme Q10 deficiencies and scavenging of free radicals (2134). However, conflicting evidence exists (44267). Additional research is needed before coenzyme Q10 supplementation can be routinely recommended during anthracycline therapy.

ANTIDIABETES DRUGS

Depletion Rating = **Insignificant Depletion** A supplement is not needed for most patients.

Metformin and sulfonylureas can modestly decrease endogenous levels of coenzyme Q10, but coenzyme Q10 supplements are not likely to be needed for patients taking these drugs.

Details

Some antidiabetes drugs, including metformin and sulfonylureas, appear to inhibit coenzyme Q10 enzyme activity and decrease endogenous levels of coenzyme Q10 (4479). However, there is no strong evidence that coenzyme Q10 depletion is the cause of antidiabetes drug-related side effects. Furthermore, taking coenzyme Q10 does not seem to improve fasting glucose levels or glycated hemoglobin in patients with diabetes (96544,97911,97918).

ANTIHYPERTENSIVE DRUGS

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Some antihypertensive drugs can modestly decrease endogenous levels of coenzyme Q10.

Details

Some antihypertensive drugs, including beta blockers, diazoxide, hydralazine, and others, appear to inhibit coenzyme Q10 enzyme activity and may decrease endogenous levels of coenzyme Q10 (4479). However, it is not clear if this reduction is clinically significant. There is no reliable evidence that coenzyme Q10 depletion contributes to antihypertensive drug side effects.

BETA-BLOCKERS

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Beta-blockers can decrease endogenous levels of coenzyme Q10.

Details

Beta-blockers are thought to inhibit coenzyme Q10 mitochondrial enzymes and decrease endogenous levels of coenzyme Q10 (3369). However, it is not clear if this reduction is clinically significant. There is no reliable evidence that coenzyme Q10 depletion contributes to beta-blocker side effects.

HMG-CoA REDUCTASE INHIBITORS ("Statins")

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Statins can halt the synthesis of coenzyme Q10, reducing endogenous levels. However, it is not clear whether this contributes to statin adverse effects, or if coenzyme Q10 supplements reduce these adverse effects.

Details

HMG-CoA reductase inhibitors can reduce serum coenzyme Q10 levels (4404,4405,4406,4407,4408,4409,4410,15115). They block the synthesis of mevalonic acid, which is a precursor of coenzyme Q10, in a dose-dependent manner (3370). Taking atorvastatin 80 mg daily for 30 days reduces coenzyme Q10 serum levels by 52%, but atorvastatin 10 mg daily or pravastatin 20 mg daily do not have this effect in healthy people (8915,12099). In other research, taking simvastatin 20 mg daily for 4 weeks reduces serum coenzyme Q10 levels by about 32%, but muscle levels increase by 47% (3367). Since coenzyme Q10 is transported with low-density lipoprotein (LDL) cholesterol, reduction in LDL cholesterol levels by a statin may increase the amount of free coenzyme Q10 in the blood that is available for uptake into muscles (15115). There is no reliable evidence that statin adverse effects such as myopathy are linked to reduced coenzyme Q10 levels in the blood, or that taking coenzyme Q10 supplements reduces statin side effects.

THIAZIDE DIURETICS

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Thiazides can modestly decrease endogenous levels of coenzyme Q10.

Details

Thiazide diuretics might decrease endogenous levels of coenzyme Q10 (95755). However, it is not clear if this reduction is clinically significant. There is no reliable evidence that coenzyme Q10 depletion contributes to thiazide c side effects.

TRICYCLIC ANTIDEPRESSANTS (TCAs)

Depletion Rating = **Insufficient Evidence to Rate** Clinical significance is not known.

Tricyclic antidepressants can modestly decrease endogenous levels of coenzyme Q10.

Details

Tricyclic antidepressants might inhibit coenzyme Q10 enzyme activity and may decrease endogenous levels of coenzyme Q10 (95756). However, it is not clear if this reduction is clinically significant. There is no reliable evidence that coenzyme Q10 depletion contributes to tricyclic antidepressant side effects.

Overdose

There is insufficient reliable information available about the presentation or treatment of overdose with coenzyme Q10.

Commercial Products Containing: Coenzyme Q10

View All

View Health Canada Licensed Products

View Certified Products

USP Verified Products

NSF Contents Certified Products

NSF Certified for Sport Products

Pharmacokinetics

Absorption: Coenzyme Q10 is a large, hydrophobic molecule, around 864 Daltons in size, and is poorly absorbed when taken orally (11031,108954,108957). Absorption from food sources appears to be equivalent to absorption from supplements (44317,44359). Coenzyme Q10 is detected in plasma about 4 hours after oral ingestion, and peak levels occur in 5-10 hours (2134,7000,8907,108954,108957). Research suggests that effervescent, fast-melting, and gel capsule formulations have similar, low oral bioavailability (11049,43979). Methods used to increase absorption include emulsification, micronization, and solubilization, as well as preparation of oil suspensions, liposomes, micelles,

nanoparticles, or colloids. These preparations generally have greater bioavailability than softgels, tablets, or powder-filled hard-shell capsules (457,43968,44098,44168,44325,44360,108957). Research in humans shows that about 7% of a dose is absorbed from lipid softgels containing non-crystalline coenzyme Q10, about 3% from lipid softgels containing crystals, and about 1% from hard-shell capsules containing dry powder (108957).

Distribution: Steady-state is reached after about 14 days in humans, when plasma levels are around 3 mcg/mL with non-crystalline coenzyme Q10 in lipid softgels, 2.5 mcg/mL with crystals in lipid softgels, and 1.5 mcg/mL with powder in hard-shell capsules (108957). From the plasma, coenzyme Q10 is distributed to the inner mitochondrial membrane of cells in cardiac tissue and sperm, and is also found in semen, platelets, mononuclear cells, and lipoproteins (7000,43956,43986,44013,44021,44039,44110,109383). It is also taken up by the liver and transferred mainly to very low-density lipoproteins (VLDL) and redistributed from the liver to the systemic blood (44242).

Elimination: The elimination half-life of coenzyme Q10 is approximately 34 hours (2134,7000,8907,44242,108954).

Mechanism of Action

General: Coenzyme Q10 is a vitamin-like, fat soluble compound present in virtually all cells and in especially high concentrations in the heart, liver, kidney, and pancreas. Within the cell, 25% to 30% of total coenzyme Q10 is found in the nucleus, 40% to 50% in the mitochondria, 15% to 20% in the microsomes, and 5% to 10% in the cytosol (2134,11892). Its primary activity is as an antioxidant, a membrane stabilizer, and a cofactor in many metabolic pathways, particularly the production of adenosine triphosphate (ATP) in oxidative respiration (2134,6037,6048,6410,11892).

The body produces adequate amounts of coenzyme Q10, so it is not considered a vitamin (11893). It is also ingested in small amounts from dietary sources, including meats and seafood. However, the amounts ingested in foods do not approach therapeutic doses (457).

The biosynthesis of coenzyme Q10 is a 17-step process that requires riboflavin, niacinamide, pantothenic acid (B5), pyridoxine, cobalamin (B12), folic acid, vitamin C, and other trace elements (89413). Acquired deficiency of coenzyme Q10 may be caused by inadequate intake of these nutrients.

Analgesic effects: Patients with fibromyalgia have reduced coenzyme Q10 levels and downregulated adenosine monophosphate-activated protein kinase (AMPK). Clinical evidence shows that oral coenzyme Q10 increases AMPK activation, which may improve symptoms of fibromyalgia, including pain (89416).

Antiaging effects: Coenzyme Q10 levels are highest during the first 20 years of life and decline with age. At age 80, coenzyme Q10 levels may be lower than at birth. In some kinds of bacteria, coenzyme Q10 seems to prolong life (11895). However, life-long administration of coenzyme Q10 to rodents doesn't affect lifespan (11896).

Some early research suggests that coenzyme Q10 may inhibit the activity of a particular aging-related enzyme. Taking coenzyme Q10 60 mg 2-3 times daily for 28 days decreases levels of the enzyme ECTO-NOX (arNOX) in saliva, perspiration, and serum (44080), and reduces the activity of arNOX in the saliva of older individuals (44081). This enzyme, which increases in activity beginning at the age of 30 years until about 55 years, is believed to propagate the aging cascade (44080).

Anticancer effects: There is interest in the use of coenzyme Q10 for cancer due to its antioxidant properties. It might also have immunostimulatory activity (3993).

A meta-analysis of preliminary clinical research in patients with breast cancer suggests that taking coenzyme Q10 100 mg daily for 45-90 days can reduce serum levels of angiogenesis and inflammatory markers, such as interleukin (IL)-6, IL-8, vascular endothelial growth factor, and tumor necrosis factor-alpha, and increase serum levels of antioxidants,

such as superoxide dismutase and glutathione, when compared with control. However, these results are limited by high heterogeneity between studies and concomitant use of other supplements (105876). There is also some evidence that coenzyme Q10 concentrations are lower in cancerous breast tissue than healthy tissue (4846,5158). Some researchers speculate that very low levels of coenzyme Q10 might be an indicator of a poor prognosis, but the effects of coenzyme Q10 on clinical outcomes have not been studied (4846).

Also, in vitro research shows that coenzyme Q10 can inhibit Cdt1, a human replication initiation protein, from interacting with geminin, a nuclear protein that downregulates Cdt1 function (44000). Theoretically, the disruption of the Cdt1-geminin interaction may induce cell death in some cancer cell lines.

Anti-chemotherapy toxicity effects: Anthracycline chemotherapeutic agents are thought to inhibit coenzyme Q10 mitochondrial enzymes and synthesis of coenzyme Q10 in the heart. Although anthracyclines seem to decrease coenzyme Q10 synthesis, in some cases coenzyme Q10 plasma levels might rise immediately after treatment with these drugs. This might be due to myocardial tissue damage resulting in release of coenzyme Q10 into plasma (14412). Preliminary research suggests that coenzyme Q10 might protect against anthracycline cardiotoxicity, possibly through correction of coenzyme Q10 deficiencies and scavenging of free radicals (2134).

Anti-inflammatory effects: A meta-analysis of the available clinical research shows that taking oral coenzyme Q10 60-500 mg daily for 8-12 weeks significantly reduces levels of tumor necrosis factor (TNF)-alpha and interleukin (IL)-6 (102009). Clinical research in adults with coronary artery disease shows that coenzyme Q10 150 mg daily for 12 weeks reduces IL-6 levels but does not significantly affect high-sensitivity C-reactive protein (hsCrp) levels (44214). In vitro evidence shows that coenzyme Q10 attenuates the effect of TNF-alpha on peroxisome proliferator-activated receptor (PPAR)-gamma, but not PPAR-alpha (44067). However, other research in humans shows that taking coenzyme Q10 has no effect on inflammatory biomarkers (96540,109383).

Antioxidant effects: Many of the therapeutic benefits of coenzyme Q10 are primarily attributed to its antioxidant effects and its role in the generation of ATP (43987,44027,44199,44210,44214,44283,44287,44305,109385,109386). A meta-analysis of clinical research shows that taking coenzyme Q10 increases antioxidative capacity and reduces malondialdehyde in most adults. However, it is unclear whether a specific population is most likely to benefit, or whether there is an optimal dose and duration of coenzyme Q10 (109385).

Genetic or acquired disorders of mitochondrial function cause increases in serum lactate and the lactate/pyruvate ratio, due to impaired oxidative metabolism. Supplementation with coenzyme Q10 seems to reduce these levels and improve exercise tolerance and function in people with these disorders (8159,8162,8163). In addition, coenzyme Q10 may be helpful for people with diseases for which coenzyme Q10 levels are often lower, including congestive heart failure (CHF), hypertension, periodontitis, certain muscular diseases, and HIV/AIDS (2134,6410).

In the treatment of congestive heart failure (CHF), the mechanism is thought to involve prevention of oxidative damage. The greatest benefit seems to occur in people with the largest deficiency of coenzyme Q10 (2134). The effect in the treatment of angina may be due to increased ATP synthesis, reduction of free radicals, or membrane protection (2134). Preliminary evidence suggests that coenzyme Q10 might enhance endothelium-independent arterial relaxation and improve endothelium-dependent vasodilation, which can lower total peripheral resistance and systolic blood pressure. This effect seems to be caused by increased endothelial production of prostacyclin (PGI2) or increased sensitivity of arterial smooth muscle to PGI2, or both (8908). It may also stabilize myocardial calcium-dependent ion channels and reduce consumption of metabolites essential for adenosine triphosphate synthesis (108954).

Coenzyme Q10 administration has been shown to be partially effective for suppressing oxidative stress in hemodialysis patients. Oxygen radical-absorbing capacity, Trolox equivalent antioxidant capacity, and levels of F2-isoprostanes are reduced by coenzyme Q10 (44027,97903).

In men with idiopathic oligoasthenoteratozoospermia (OAT), coenzyme Q10 improved total antioxidant capacity, catalase activity, and superoxide dismutase activity in the semen (102008). This antioxidant activity is thought to contribute to improvements in sperm concentration and motility (17413,89422,102008).

In patients with diabetes, the coenzyme Q10 content of LDL cholesterol may play a role in its resistance to in vitro oxidation (44353). In vitro evidence shows that coenzyme Q10 reduces LDL oxidation in lipoproteins (44151,43956,44327).

Cardiovascular effects: Coenzyme Q10 increases plasma levels of high density lipoprotein (HDL) cholesterol, vitamin E, and vitamin C; and decreases levels of total cholesterol, low density lipoprotein (LDL) cholesterol, and products of lipid peroxidation such as thiobarbituric acid reactive substances (TBARS), malondialdehyde, and diene conjugates (3365,15115,17650,44214). In patients at risk for future coronary events, coenzyme Q10 may prevent thrombosis and have protective effects on vascular and myocardial remodeling and endothelial function (10152). Hypothetically, the direct action of coenzyme Q10 on vascular endothelium might reduce blood pressure by reducing peripheral vascular resistance (95607).

Coenzyme Q10 can undergo oxidation/reduction reactions in various cell membranes such as lysosomes, Golgi, or plasma membranes. The proton gradient caused by the redox ability of coenzyme Q10 provides a basis for antioxidant action either directly or by regeneration of vitamin E (tocopherol) and ascorbate (8913). Preliminary research suggests that decreased redox status of coenzyme Q10 might indicate a higher risk for coronary heart disease in people with familial hyperlipidemia (8914). Patients with coronary artery disease appear to have a lower ratio of ubiquinol to ubiquinone compared to healthy individuals, suggesting that lipoproteins of CAD patients are more susceptible to free radical reactions compared to healthy individuals (44307).

In elderly individuals with low selenium levels, a combination of coenzyme Q10 200 mg daily plus selenium yeast 200 mcg daily for 48 months improves cardiac function, reduces cardiac wall tension, improves biomarkers of cardiovascular risk, and lowers cardiovascular mortality during 12 years of follow-up. The combination reduces inflammation and oxidative stress, leading to reduced fibrosis and improved myocardial function (108955).

Fenofibrate and coenzyme Q10 seem to improve endothelial and non-endothelial forearm vasodilator function in patients with type 2 diabetes and dyslipidemia (11877).

Coenzyme Q10 has been shown to improve diastolic function in patients taking statins (43936).

Preoperative coenzyme Q10 increases myocardial and cardiac mitochondrial coenzyme Q10 levels, improves mitochondrial efficiency, and increases myocardial tolerance to oxidative stress in elderly patients undergoing cardiac surgery (43920,43937,44021).

Dermatologic effect: In vitro, coenzyme Q10 inhibits UVB-induced damage in keratinocytes and fibroblasts (44082). Also, the production of reactive oxygen species and interleukin-6, and damage to DNA are reduced, and matrix metalloproteinases are inhibited. Theoretically, these effects may prevent degradation of dermal fiber components of the skin and attenuate wrinkling. Other in vitro research shows that coenzyme Q10 may attenuate skin aging by protecting dermal and epidermal cells against oxidative stress-induced cell death and enhancing the synthesis of basement membrane components (laminin 332, type IV and VII collagens) (44133). Preliminary clinical evidence suggests that applying a coenzyme Q10 1% cream to the skin for 5 months reduces objective wrinkle scores (44082).

Exercise effects: Coenzyme Q10 appears to increase fat oxidation and enhance autonomic nervous activity during low-intensity exercise in healthy individuals (44049). Other research shows that coenzyme Q10 decreases the resting and post-exercise inorganic phosphate (Pi) to phosphocreatine (PCr) ratio and the half-time of recovery for phosphocreatine in muscles of post-polio subjects, suggesting that coenzyme Q10 affects muscle energy metabolism in these patients (44319). However, in humans, oral coenzyme Q10 does not seem to improve power or perceived exertion. There is some evidence that it slightly improves tolerance to higher workloads and reduces exercise-induced fatigue (2109,2110,8911,44006,44122,44227). Coenzyme Q10 seems to provide antioxidant effects (99429). In addition, based on blood levels of bone and metabolic markers, taking the ubiquinol form of coenzyme Q10 might improve bone formation and muscle recovery following strenuous exercise (104552).

Hepatic effects: There is interest in using coenzyme Q10 as a hepatoprotective agent. In clinical research in adults with nonalcoholic fatty liver disease (NAFLD), taking coenzyme Q10 daily for 12 weeks decreased plasma levels of liver enzymes, C-reactive protein (CRP), and tumor necrosis factor-alpha (TNF-alpha). Coenzyme Q10 also increased levels of adiponectin and serum leptin (97907).

Immunostimulating effects: In theory, coenzyme Q10 may have positive effects on immune response (44244). Coenzyme Q10 has been shown to increase blood levels of IgG, T4-lymphocytes, and ratio of T4/T8 lymphocytes (44297). Evidence from animal research also shows that coenzyme Q10 can decrease peripheral blood lymphocyte proliferation in response to concanavalin A in ascites-susceptible broilers (43985). In vitro research shows that coenzyme Q10 decreases the secretion of TNF-alpha and IL-2 in human peripheral blood mononuclear cells (44169).

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Mitochondrial effects: Coenzyme Q10 appears to be a factor in Parkinson disease. Parkinson disease might be caused by impaired function of the mitochondrial electron transport chain, and particularly the mitochondrial enzymes, complex I and complex II (44140). Coenzyme Q10 is the electron acceptor for these complexes. People with Parkinson disease seem to have lower levels of coenzyme Q10 in platelet mitochondria (43902,44140,44321). Preliminary research in humans suggests that coenzyme Q10 increases the activity of complex 1 (43902,44321). Also, preclinical research suggests that supplementation increases cerebral concentrations of coenzyme Q10 and reduces the loss of dopamine and dopaminergic axons in experimental models of Parkinson disease (8938,8939). Evidence from in vitro research suggests that coenzyme Q10 attenuates changes in Parkinson disease cybrid peroxide, protein carbonyl, and protein sulfhydryl levels via mechanisms that may include restoration of ATP to control levels, and normalization of Parkinson disease cybrid free tubulin:polymerized tubulin ratios (44046).

There is also interest in using coenzyme Q10 for Huntington disease, which is also thought to be a mitochondrial disorder. In animal models of Huntington disease, orally administered coenzyme Q10 extends survival and delays development of motor deficits, weight loss, cerebral atrophy, and neuronal changes (8941). Usefulness in humans hasn't been demonstrated at doses of 600 mg per day or less (8940). Some researchers suggest that L-carnitine and coenzyme Q10 might have an additive or synergistic effect. Both coenzyme Q10 and L-carnitine are involved with maintaining mitochondrial energy production in cells and may help protect against oxidative and toxin-induced damage (3653,9603), but it isn't known whether this has any clinical significance.

For migraine headaches, coenzyme Q10 might work by improving mitochondrial oxidative phosphorylation, which appears to be impaired in some patients with migraines (8135,11897). Some people with migraine headache might have low levels of coenzyme Q10. The reference range for serum total coenzyme Q10 levels is 0.5-1.5 mcg/mL. As many as 32.9% of pediatric and adolescent migraine patients have serum coenzyme Q10 levels below the reference range (15256).

In vitro evidence suggests coenzyme Q10 might prevent cardiotoxicity caused by phenothiazines and tricyclic antidepressants. It seems to block mitochondrial dysfunction induced by these drugs (8959). In bipolar disorder, coenzyme Q10 might work by facilitating mitochondrial ATP production, which data suggests is impaired in patients with bipolar disorder (95606).

In patients with mitochondrial cytopathies, including mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS); mitochondrial DNA deletions; and other mitochondrial diseases, taking a combination of creatine monohydrate, coenzyme Q10, and lipoic acid supplementation lowers resting plasma lactate and urinary 8-isoprostanes, suggesting reduced oxidative stress, and attenuates the decline in peak ankle dorsiflexion strength in all patient groups (43976). Other preliminary research suggests that coenzyme Q10 improves brain and muscle mitochondrial respiration in patients with mitochondrial cytopathies (43901).

In fibroblasts from patients with coenzyme Q10 deficiency, coenzyme Q10 partially restores the decreased activities of complex II+III, complex III, and complex IV; the reduced expression of various mitochondrial proteins involved in oxidative phosphorylation; the potential of the mitochondrial membrane; the increased production of reactive oxygen species; the activation of mitochondrial permeability transition; the reduced cellular growth rates; and the accompanying autophagy (44085).

Musculoskeletal effects: HMG-CoA reductase inhibitors (statins) reduce serum coenzyme Q10 levels (4404,4405,4406,4407,4408,4409,4410,15115). But levels in muscles don't appear to be affected (3367). Some researchers think statin-induced myopathy may be related to mitochondrial dysfunction caused by reduced coenzyme Q10 levels. Coenzyme Q10 and cholesterol share common synthetic pathways. Statins block the synthesis of both. Coenzyme Q10 does not affect the cholesterol-lowering effect of statins (11898).

Coenzyme Q10 is transported with low-density lipoprotein (LDL) cholesterol. Some evidence indicates that the statin-related decrease in coenzyme Q10 levels is due to the reduction of cholesterol levels by statins. Increasing cholesterol reduction is correlated with increased reduction in coenzyme Q10 plasma levels (15115). The cholesterol absorption inhibitor ezetimibe (Zetia) does not appear to significantly affect coenzyme Q10 plasma levels (15115).

Coenzyme Q10 may be a biomarker to determine if patients have fibromyalgia. Fibromyalgia may cause an altered distribution of coenzyme Q10 in the body, with higher levels of coenzyme Q10 in the plasma; as well as reduced cell uptake and metabolism of coenzyme Q10 into mononuclear cells. The reduction in coenzyme Q10 within the mononuclear cells may lead to higher levels of reactive oxygen species causing oxidative stress in patients with fibromyalgia (17705). Early research suggests that taking coenzyme Q10 along with ginkgo improves physical fitness levels, emotional feelings, social activities, overall health, and pain in fibromyalgia patients (17716).

Neurological effects: Animal research suggests that coenzyme Q10 reduces beta-amyloid plaque production and deposit in experimental models of Alzheimer disease (44002,44140). A decrease in malondialdehyde levels and upregulated activity of superoxide dismutase may play a role in this effect. However, other evidence from in vitro research suggests that coenzyme Q10 facilitates tau aggregation and may play a role in the formation of Hirano bodies (44017).

Ocular effects: There is significant clinical interest in using coenzyme Q10 for various eye disorders. In vitro research suggests that coenzyme Q10 prevents apoptotic cell death in human lens epithelial cells. A reduction in oxidative stress and the stabilization of the BAX:Bcl-2 ratio plays a role (44170). There is also interest in whether antioxidant effects of coenzyme Q10 might reverse vision loss caused by vascular retinal diseases. A small case series in patients with different retinal vascular diseases such as ischemic optic neuropathy and retinal vein occlusion has found that taking coenzyme Q10 with vitamins is associated with modest vision improvement when compared with baseline (103779).

Otic effects: Animal research shows that coenzyme Q10 prevents age-related hearing loss in mice (44145). The mechanism of action involves the suppression of Bak expression in the cochlea, which reduces cochlear cell death and slows the progression of AHL.

Renal effects: There is interest in using coenzyme Q10 and selenium to improve kidney function. A clinical study in healthy older adults ages 70-88 years shows that taking coenzyme Q10 (Bio-Quinon, Pharma Nord) 200 mg with organic selenium yeast tablets (SelenoPrecise, Pharma Nord) 200 mcg daily for 2 years seems to increase estimated glomerular filtration rate (eGFR) from 58.3 to 63.7 mL/min/1.73 m^2, compared with no change in the placebo group (105066). This study was funded by the supplement manufacturer.

Respiratory effects: In patients with sleep apnea, an antioxidant cocktail containing coenzyme Q10 reduces progressive augmentation and ventilatory long-term facilitation of respiratory motor output, which are normally enhanced in these patients due to exposure to intermittent hypoxia (44137).

Classifications

Immunomodulators

References

See Monograph References

Monographs are reviewed on a regular schedule. See our Editorial Principles and Process for details. The literature evaluated in this monograph is current through 7/31/2023. This monograph was last modified on 1/13/2023. If you have comments or suggestions, please tell the editors.