

## Micronutrients for Older Adults

Vitamin and mineral dietary intake recommendations for individuals over the age of 50 years. For each micronutrient, the Food and Nutrition Board of the Institute of Medicine establishes a recommended dietary allowance (RDA) or adequate intake (AI). Generally, the Linus Pauling Institute supports the recommendations of the Food and Nutrition Board, but any discrepancies in dietary recommendations are listed in the rightmost column of the table. Additionally, more information on the Linus Pauling Institute recommendation for a specific micronutrient can be found by clicking on the name of the micronutrient of interest.

<b>Micronutrient Requirements for Older Adults (&gt; 50 years)</b>			
	<b>Food and Nutrition Board Recommendations (RDA except where otherwise noted)</b>		<b>Linus Pauling Institute Recommendation</b>
<b>Micronutrient</b>	<b>Men</b>	<b>Women</b>	
<i>Vitamins</i>			
<a href="#">Biotin</a>	30 mcg/day (AI)	30 mcg/day (AI)	
<a href="#">Folic acid</a>	400 mcg/day	400 mcg/day	
<a href="#">Niacin</a>	16 mg NE*/day	14 mg NE/day	
<a href="#">Pantothenic acid</a>	5 mg/day (AI)	5 mg/day (AI)	
<a href="#">Riboflavin</a>	1.3 mg/day	1.1 mg/day	
<a href="#">Thiamin</a>	1.2 mg/day	1.1 mg/day	
<a href="#">Vitamin A</a>	900 mcg (3,000 IU)/day	700 mcg (2,333 IU)/day	

<a href="#">Vitamin B<sub>6</sub></a>	1.7 mg/day	1.5 mg/day	
<a href="#">Vitamin B<sub>12</sub></a>	2.4 mcg/day <sup>#</sup>	2.4 mcg/day <sup>#</sup>	100-400 mcg/day of crystalline vitamin B <sub>12</sub> for those > 50 years
<a href="#">Vitamin C</a>	90 mg/day	75 mg/day	≥ 400 mg/day
<a href="#">Vitamin D</a> (51-70 years)	10 mcg (400 IU)/day (AI)	10 mcg (400 IU)/day	800 IU/day
<a href="#">Vitamin D</a> (> 70 years)	15 mcg (600 IU)/day (AI)	15 mcg (600 IU)/day	800 IU/day
<a href="#">Vitamin E</a>	15 mg (22.5 IU)/day	15 mg (22.5 IU)/day	200 IU/day
<a href="#">Vitamin K</a>	120 mcg/day (AI)	90 mcg/day (AI)	
<i>Minerals</i>			
<a href="#">Calcium</a>	1,200 mg/day (AI)	1,200 mg/day (AI)	
<a href="#">Chromium</a>	30 mcg/day (AI)	20 mcg/day (AI)	
<a href="#">Copper</a>	900 mcg/day	900 mcg/day	
<a href="#">Fluoride</a>	4 mg/day (AI)	3 mg/day (AI)	
<a href="#">Iodine</a>	150 mcg/day	150 mcg/day	
<a href="#">Iron</a>	8 mg/day	8 mg/day	No supplement
<a href="#">Magnesium</a>	420 mg/day	320 mg/day	No supplement providing > 350 mg/day
<a href="#">Manganese</a>	2.3 mg/day (AI)	1.8 mg/day (AI)	
<a href="#">Molybdenum</a>	45 mcg/day	45 mcg/day	

<a href="#">Phosphorus</a>	700 mg/day	700 mg/day	
<a href="#">Potassium</a>	4,700 mg/day (AI)	4,700 mg/day (AI)	
<a href="#">Selenium</a>	55 mcg/day	55 mcg/day	
<a href="#">Sodium (51-70 years)</a>	1.3 g/day (AI)	1.3 g/day (AI)	
<a href="#">Sodium (&gt; 70 years)</a>	1.2 g/day (AI)	1.2 g/day (AI)	
<a href="#">Zinc</a>	11 mg/day	8 mg/day	

\*NE, niacin equivalent: 1 mg NE = 60 mg of tryptophan = 1 mg niacin

#Vitamin B<sub>12</sub> intake should be from supplements or fortified foods due to the age-related increase in malabsorption

Abbreviations: mcg=microgram; mg=milligram; g=gram;

IU=International Unit; RDA=Recommended Dietary Allowance;

AI=Adequate Intake

## LINUS PAULING INSTITUTE RECOMMENDATIONS

### *Vitamins*

#### Biotin:

Presently, there is no indication that older adults have an increased requirement for biotin. If dietary biotin intake is not sufficient, a daily multivitamin/multimineral supplement will generally provide an intake of at least 30 mcg of biotin/day.

#### Folic acid:

The Linus Pauling Institute recommends that adults take a 400 mcg supplement of folic acid daily, in addition to folate and folic acid consumed in the diet. A daily multivitamin-mineral supplement, containing 100% of the Daily Value (DV) for folic acid provides 400 mcg of folic acid. Even with a larger than average intake of folic acid from fortified foods, it is unlikely that an individual's daily folic acid

intake would regularly exceed the tolerable upper intake level of 1,000 mcg/day established by the Food and Nutrition Board. The recommendation for 400 mcg/day of supplemental folic acid as part of a daily multivitamin-multimineral supplement, in addition to a folate-rich diet, is especially important for older adults because blood homocysteine levels tend to increase with age.

#### Niacin:

Dietary surveys indicate that 15% to 25% of older adults do not consume enough niacin in their diets to meet the RDA (16 mg NE/day for men and 14 mg NE/day for women), and that dietary intake of niacin decreases between the ages of 60 and 90 years. Thus, it is advisable for older adults to supplement their dietary intake with a multivitamin/multimineral supplement, which will generally provide at least 20 mg of niacin daily.

#### Pantothenic acid:

Presently, there is little evidence that older adults differ in their intake or requirement for pantothenic acid. Most multivitamin/multimineral supplements provide at least 5 mg/day of pantothenic acid. The Linus Pauling Institute supports the recommendation by the Food and Nutrition Board of 5 mg/day of pantothenic acid for older adults. A varied diet should provide enough pantothenic acid for most people. Following the Linus Pauling Institute recommendation to take a daily multivitamin-mineral supplement, containing 100% of the Daily Value (DV), will ensure an intake of at least 5 mg/day of pantothenic acid.

#### Riboflavin:

Some experts in nutrition and aging feel that the RDA (1.3 mg/day for men and 1.1 mg/day for women) leaves little margin for error in people over 50 years of age. A recent study of independently living people between 65 and 90 years of age found that almost 25% consumed less than the recommended riboflavin intake, and 10% had biochemical evidence of deficiency. Additionally, epidemiological studies of cataract prevalence indicate that riboflavin intakes of 1.6 to

2.2 mg/day may reduce the risk of developing age-related cataracts. Individuals whose diets may not supply adequate riboflavin, especially those over 50, should consider taking a multivitamin/multimineral supplement, which generally provides at least 1.7 mg of riboflavin/day.

#### Thiamin:

Presently, there is no evidence that the requirement for thiamin is increased in older adults, but some studies have found inadequate dietary intake and thiamin insufficiency to be more common in elderly populations. Thus, it would be prudent for older adults to take a multivitamin/multimineral supplement, which will generally provide at least 1.5 mg of thiamin/day.

#### Vitamin A:

Currently, there is little evidence that the requirement for vitamin A in older adults differs from that of younger adults. Additionally, because intestinal absorption of vitamin A may increase with age, vitamin A toxicity may occur at lower doses in older adults than in younger adults. Following the Linus Pauling Institute's recommendation to take a multivitamin/multimineral supplement daily could supply as much as 5,000 IU/day of retinol, the amount that has been associated with adverse effects on bone health in older adults. For this reason, we recommend taking a multivitamin/multimineral supplement that provides no more than 2,500 IU of vitamin A or a supplement that provides 5,000 IU of vitamin A, of which at least 50% comes from beta-carotene. High potency vitamin A supplements should not be used without medical supervision due to the risk of toxicity.

#### Vitamin B<sub>6</sub>:

Metabolic studies have indicated that the requirement for vitamin B<sub>6</sub> in older adults is approximately 2.0 mg daily; this requirement could be even higher if the effect of marginally deficient vitamin B<sub>6</sub> intakes on immune function and homocysteine levels are clarified. Despite evidence that the requirement for vitamin B<sub>6</sub> may be slightly higher in

older adults, several surveys have found that over half of individuals over age 60 consume less than the current RDA (1.7 mg/day for men and 1.5 mg/day for women). For these reasons, the Linus Pauling Institute recommends that older adults take a multivitamin / multimineral supplement, which generally provides at least 2.0 mg of vitamin B<sub>6</sub> daily.

#### Vitamin B<sub>12</sub>:

Because vitamin B<sub>12</sub> malabsorption and vitamin B<sub>12</sub> deficiency are more common in older adults, some respected nutritionists recommend that adults older than 50 years take 100 to 400 mcg/day of supplemental vitamin B<sub>12</sub>, an amount provided by a number of vitamin B-complex supplements.

#### Vitamin C:

Although it is not yet known with certainty whether older adults have higher requirements for vitamin C than younger people, some older populations have been found to have vitamin C intakes considerably below the RDA of 75 mg/day and 90 mg/day for women and men, respectively. A vitamin C intake of at least 400 mg daily may be particularly important for older adults who are at higher risk for chronic diseases. Consuming at least five servings (2½ cups) of fruits and vegetables daily may provide about 200 mg of vitamin C. Most multivitamin supplements provide 60 mg of vitamin C.

#### Vitamin D:

In addition to the 400 IU (10 mcg) of vitamin D provided by a multivitamin supplement, people over the age of 65 and people who get minimal sun exposure throughout the year should take an additional vitamin D supplement of 400 IU/day (10 mcg/day) to provide a total of 800 IU/day (20 mcg/day).

#### Vitamin E:

Scientists at the Linus Pauling Institute feel there exists credible evidence that taking a supplement of 200 IU of natural source d- $\alpha$ -tocopherol (RRR- $\alpha$ -tocopherol) daily with a meal may help protect

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adults from chronic diseases like heart disease, stroke, neurodegenerative diseases, and some types of cancer. This recommendation is also appropriate for older adults. The amount of  $\alpha$ -tocopherol required for such beneficial effects appears to be much greater than that which could be achieved through diet alone. Because supplements containing 200 IU of d- $\alpha$ -tocopherol are often as expensive as supplements containing 400 IU of d- $\alpha$ -tocopherol, a less expensive alternative may be to take 400 IU of d- $\alpha$ -tocopherol every other day. It is important that  $\alpha$ -tocopherol supplements be taken with a meal containing some fat.

#### Vitamin K:

Older adults are at increased risk of osteoporosis and hip fracture. Because adequate intake of vitamin K is essential in maintaining bone health, the Linus Pauling Institute recommends that adults take a multivitamin-mineral supplement and consume at least 1 cup of dark green leafy vegetables daily. Although the AI for vitamin K was recently increased, it is not clear if it will be enough to optimize the gamma-carboxylation of vitamin K-dependent proteins in bone (see Osteoporosis section of the article on vitamin K). Multivitamins generally contain 10 to 25 mcg of vitamin K, whereas vitamin K or “bone” supplements may contain 100 to 120 mcg of vitamin K. To consume the amount of vitamin K associated with a decreased risk of hip fracture in the Framingham Heart Study (about 250 mcg/day), an individual would need to eat a little more than 1/2 cup of chopped broccoli or a large salad of mixed greens every day. In addition to taking a multivitamin-mineral supplement and eating at least 1 cup of dark green leafy vegetables daily, replacing dietary saturated fats (e.g., butter and cheese) with monounsaturated fats (e.g., olive and canola oils) will increase dietary vitamin K intake and may also decrease the risk of cardiovascular diseases.

### ***Minerals***

#### Calcium:

To minimize bone loss, older men and postmenopausal women

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should consume a total (diet plus supplements) of 1,200 mg/day of calcium. Taking a multivitamin/multimineral supplement containing at least 10 mcg (400 IU)/day of vitamin D<sub>3</sub> will help to ensure adequate calcium absorption.

#### Chromium:

Although the requirement for chromium is not known to be higher for older adults, one study found that chromium concentrations in hair, sweat, and urine decreased with age. Following the Linus Pauling Institute recommendation to take a multivitamin / multimineral supplement containing 100% of the daily values (DV) of most nutrients should provide sufficient chromium for most older adults.

Because impaired glucose tolerance and type 2 diabetes are associated with potentially serious health problems, individuals considering high-dose chromium supplementation to treat either condition should do so in collaboration with a qualified health care provider.

#### Copper:

Aging has not been associated with significant changes in the requirement for copper; thus, the Linus Pauling Institute recommendation for copper intake in older adults are the same as younger adults. The RDA for copper (900 mcg/day for all adults) is sufficient to prevent deficiency, but the lack of clear indicators of copper nutritional status in humans makes it difficult to determine the level of copper intake most likely to promote optimum health or prevent chronic disease. A varied diet should provide enough copper for most people. For those who are concerned that their diet may not provide adequate copper, a multivitamin/multimineral supplement will generally provide at least the RDA for copper.

#### Fluoride:

The safety and public health benefits of optimally fluoridated water for prevention of tooth decay in people of all ages have been well-established. The Linus Pauling Institute supports the recommendations of the American Dental Association and the [www.healthoracle.org](http://www.healthoracle.org)



Centers for Disease Control and Prevention, which include optimally fluoridated water as well as the use of fluoride toothpaste, fluoride mouthrinse, fluoride varnish, and when necessary, fluoride supplementation. Due to the risk of fluorosis, any fluoride supplementation should be prescribed and closely monitored by a dentist or physician.

#### Iodine:

The RDA for iodine (150 mcg/day for men and women) is sufficient to ensure normal thyroid function. There is presently no evidence that iodine intakes higher than the RDA are beneficial. Most people in the U.S. consume more than sufficient iodine in their diets, making supplementation unnecessary.

#### Iron:

A study in an elderly population found that high iron stores were much more common than iron deficiency. Thus, older adults should not generally take nutritional supplements containing iron unless they have been diagnosed with iron deficiency. Moreover, it is extremely important to determine the underlying cause of the iron deficiency, rather than simply treating it with iron supplements.

#### Magnesium:

Older adults are less likely than younger adults to consume enough magnesium to meet their needs and should therefore take care to eat magnesium-rich foods in addition to taking a multivitamin-mineral supplement daily. Because older adults are more likely to have impaired kidney function, they should avoid taking more than 350 mg/day of supplemental magnesium without medical consultation (see Safety section of the article on magnesium).

#### Manganese:

The requirement for manganese is not known to be higher for older adults compared to younger adults. However, liver disease is more common in older adults and may increase the risk of manganese toxicity by decreasing the elimination of manganese from the body

(see Toxicity section of the article on manganese). Manganese supplementation beyond 100% of the DV (2 mg/day) is not recommended.

#### Molybdenum:

Because aging has not been associated with significant changes in the requirement for molybdenum, the Linus Pauling Institute recommendation for older adults is the same as that for younger adults. Specifically, the RDA for molybdenum, 45 mcg/day for adults of all ages, is sufficient to prevent deficiency. Although the intake of molybdenum most likely to promote optimum health is not known, there is presently no evidence that intakes higher than the RDA are beneficial. Most people in the U.S. consume more than sufficient molybdenum in their diets, making supplementation unnecessary. Following the Linus Pauling Institute's general recommendation to take a multivitamin-mineral supplement that contains 100% of the daily values (DV) for most nutrients is likely to provide 75 mcg/day of molybdenum because the DV for molybdenum has not been revised to reflect the most recent RDA. Although the amount of molybdenum presently found in most multivitamin-mineral supplements is higher than the RDA, it is well below the tolerable upper intake level (UL) of 2,000 mcg/day and should be safe for adults.

#### Phosphorus:

At present, there is no evidence that the phosphorus requirements of older adults differ from that of younger adults (700 mg/day). Although few multivitamin/multimineral supplements contain more than 15% of the current RDA for phosphorus, a varied diet should easily provide adequate phosphorus for most people.

#### Potassium:

A diet supplying at least 4.7 grams/day of potassium is appropriate for healthy older adults because such diets are associated with decreased risk of stroke, hypertension, osteoporosis, and kidney stones. This recommendation does not apply to individuals who have

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been advised to limit potassium consumption by a health care professional (see Safety section of the article on potassium).

#### Selenium:

Aging has not been associated with significant changes in the requirement for selenium. The Linus Pauling Institute supports the recommendation of the Food and Nutrition Board, which is 55 mcg of selenium/day for adults of all ages. Although the amount of selenium in multivitamin/multimineral supplements varies considerably, multivitamin-mineral supplements rarely provide more than the Daily Value (DV) of 70 mcg. The average American diet is estimated to provide about 100 mcg/day of selenium. Thus, eating a varied diet and taking a daily multivitamin supplement should provide sufficient selenium.

#### Sodium:

There is consistent evidence that diets relatively low in salt (5.8 grams/day or less) and high in potassium (at least 4.7 grams/day) are associated with decreased risk of high blood pressure and the associated risks of cardiovascular and kidney diseases. Diets low in sodium and rich in potassium are likely to be of particular benefit for older individuals, who are at increased risk of high blood pressure. Moreover, the DASH trial demonstrated that a diet emphasizing fruits, vegetables, whole grains, nuts, and low-fat dairy products substantially lowered blood pressure, an effect that was enhanced by reducing salt intake to 5.8 grams/day or less. For more information on the DASH diet, see the article on sodium. The Linus Pauling Institute recommends a diet that is rich in fruits and vegetables (at least 5 servings/day) and limits processed foods that are high in salt. Sensitivity to the blood pressure-raising effects of salt increases with age; therefore, consuming diets that are low in salt and high in potassium may especially benefit older adults.

Diets rich in potassium (at least 4.7 grams/day) and low in salt (5.8 grams/day or less) are likely to be of particular benefit for older adults, who are at increased risk of high blood pressure along with its associated risks of cardiovascular and kidney diseases. Since

sensitivity to the blood pressure-raising effects of salt increases with age, consuming diets that are low in salt and high in potassium may especially benefit older adults.

#### Zinc:

Although the requirement for zinc is not known to be higher for older adults, their average zinc intake tends to be considerably less than the RDA. A reduced capacity to absorb zinc, increased likelihood of disease states that alter zinc utilization, and increased use of drugs that increase zinc excretion may contribute to an increased risk of mild zinc deficiency in older adults. Because the consequences of mild zinc deficiency, such as impaired immune system function, are particularly relevant to the health of older adults, they should pay particular attention to maintaining adequate zinc intake.

### ***Other Nutrients***

#### L-carnitine:

Age-related declines in mitochondrial function and increases in mitochondrial oxidant production are thought to be important contributors to the adverse effects of aging. Tissue L-carnitine levels have been found to decline with age in humans and animals. One study found that feeding aged rats acetyl-L-carnitine (ALCAR) reversed the age-related declines in tissue L-carnitine levels and also reversed a number of age-related changes in liver mitochondrial function; however, high doses of ALCAR increased liver mitochondrial oxidant production. More recently, two studies found that supplementing aged rats with either ALCAR or alpha-lipoic acid, a mitochondrial cofactor and antioxidant, improved mitochondrial energy metabolism, decreased oxidative stress, and improved memory. Interestingly, co-supplementation of ALCAR and alpha-lipoic acid resulted in even greater improvements than either compound administered alone. Likewise, several studies have reported that supplementing rats with both L-carnitine and alpha-lipoic acid blunts the age-related increases in reactive oxygen species

(ROS), lipid peroxidation, protein carbonylation, and DNA strand breaks in a variety of tissues (heart, skeletal muscle, brain). Improvements in mitochondrial enzyme and respiratory chain activities were also observed. While these findings are very exciting, it is important to realize that these studies used relatively high doses (100 to 300 mg/kg body weight/day) of the compounds and only for a short time (one month). It is not yet known whether taking relatively high doses of these two naturally occurring substances will benefit rats in the long-term or will have similar effects in humans. Clinical trials in humans are planned, but it will be several years before the results are available. If you choose to take carnitine supplements, the Linus Pauling Institute recommends acetyl-L-carnitine at a daily dose of 500 to 1,000 mg.

#### Choline:

Little is known regarding the amount of dietary choline most likely to promote optimum health or prevent chronic disease in older adults. At present, there is no evidence to support a different intake of choline from that of younger adults (550 mg/day for men and 425 mg/day for women).

#### Coenzyme Q<sub>10</sub>:

According to the free radical and mitochondrial theories of aging, oxidative damage of cell structures by reactive oxygen species (ROS) plays an important role in the functional declines that accompany aging. ROS are generated by mitochondria as a byproduct of ATP production. If not neutralized by antioxidants, ROS may damage mitochondria over time, causing them to function less efficiently and to generate more damaging ROS in a self-perpetuating cycle. Coenzyme Q<sub>10</sub> plays an important role in mitochondrial ATP synthesis and functions as an antioxidant in mitochondrial membranes. Moreover, tissue levels of coenzyme Q<sub>10</sub> have been reported to decline with age. One of the hallmarks of aging is a decline in energy metabolism in many tissues, especially liver, heart, and skeletal muscle. It has been proposed that age-associated declines in tissue coenzyme Q<sub>10</sub> levels may play a role in this decline. In recent

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studies, lifelong dietary supplementation with coenzyme Q<sub>10</sub> did not increase the life spans of rats or mice; however, one study showed that coenzyme Q<sub>10</sub> supplementation attenuates the age-related increase in DNA damage. Presently, there is no scientific evidence that coenzyme Q<sub>10</sub> supplementation prolongs life or prevents age-related functional declines in humans.

### Essential Fatty Acids:

Alpha-linolenic acid (ALA), an omega-3 fatty acid, and linoleic acid (LA), an omega-6 fatty acid, are considered essential fatty acids because they cannot be synthesized by humans. In 2002, the Food and Nutrition Board of the U.S. Institute of Medicine established adequate intake (AI) levels for omega-6 and omega-3 fatty acids. Essential fatty acid recommendations for adults over the age of 50 are listed in the table below. For more information on ALA and LA, see the article on essential fatty acids.

<b>Adequate Intake (AI) for Essential Fatty Acids</b>		
<b>Essential Fatty Acid</b>	<b>Men</b>	<b>Women</b>
ALA (> 50 years)	1.6 g/day	1.1 g/day
LA (> 50 years)	14.0 g/day	11.0 g/day
Abbreviations: ALA= $\alpha$ -linolenic acid; LA=linoleic acid; g=grams		

### International Recommendations

The European Commission recommends an omega-6 fatty acid intake of 4-8% of energy and an omega-3 fatty acid intake of 2 g/day of ALA and 200 mg/day of long-chain omega-3 fatty acids (EPA and DHA). The World Health Organization recommends an omega-6 fatty acid intake of 5-8% of energy and an omega-3 fatty acid intake of 1-2% of energy. However, the Japan Society for Lipid Nutrition has recommended that LA intake be reduced to 3-4% of energy in

Japanese people whose omega-3 fatty acid intakes average 2.6 g/day, including about 1 g/day of EPA + DHA.

### **American Heart Association Recommendation**

The American Heart Association recommends that people without documented CHD eat a variety of fish (preferably oily) at least twice weekly, in addition to consuming oils and foods rich in ALA. People with documented CHD are advised to consume approximately 1 g/day of EPA + DHA preferably from oily fish, or to consider EPA + DHA supplements in consultation with a physician. Patients who need to lower serum triglycerides may take 2-4 g/day of EPA + DHA supplements under a physician's care.

#### **Lipoic Acid:**

Lipoic acid alone or in combination with other antioxidants or L-carnitine has been found to improve measures of memory in animal models of age-associated cognitive decline, including rats, mice, and dogs. However, it is not clear whether oral lipoic acid supplementation can slow cognitive decline related to aging or other pathology in humans. An uncontrolled, open-label trial in nine patients with Alzheimer's disease and related dementias, who were also taking acetylcholinesterase inhibitors, reported that oral supplementation with 600 mg/day of racemic lipoic acid appeared to stabilize cognitive function over a one-year period. However, the significance of these findings is difficult to assess without a control group for comparison. A randomized controlled trial found that oral supplementation with 1,200 mg/day of racemic lipoic acid for ten weeks was of no benefit in treating HIV-associated cognitive impairment. Although studies in animals suggest that lipoic acid may be helpful in slowing age-related cognitive decline, randomized controlled trials are needed to determine whether lipoic acid supplementation is effective in preventing or slowing cognitive decline associated with age or neurodegenerative disease. If you choose to take lipoic acid supplements, the Linus Pauling Institute

recommends a daily dose of 200-400 mg/day of racemic lipoic acid for generally healthy people.

### ***Phytochemicals***

Flavonoids:

The prevalence of several neurodegenerative disease increases with advanced age. Inflammation, oxidative stress and transition metal accumulation appear to play a role in the pathology of several neurodegenerative diseases, including Parkinson's disease and Alzheimer's disease. Because flavonoids have anti-inflammatory, antioxidant and metal chelating properties, scientists are interested in the neuroprotective potential of flavonoid-rich diets or individual flavonoids. At present, the extent to which various dietary flavonoids and flavonoid metabolites cross the blood brain barrier in humans is not known. Although flavonoid-rich diets and flavonoid administration have been found to prevent cognitive impairment associated with aging and inflammation in some animal studies, prospective cohort studies have not found consistent inverse associations between flavonoid intake and the risk of dementia or neurodegenerative disease in humans. In a cohort of Japanese-American men followed for 25-30 years, flavonoid intake from tea during midlife was not associated with the risk of Alzheimer's or other types of dementia in late life. Surprisingly, higher intakes of isoflavone-rich tofu during midlife were associated with cognitive impairment and brain atrophy in late life (see the article on Soy Isoflavones). A prospective study of Dutch adults found that total dietary flavonoid intake was not associated with the risk of developing Parkinson disease or Alzheimer's disease, except in current smokers whose risk of Alzheimer's disease decreased by 50% for every 12 mg increase in daily flavonoid intake. In contrast, a study of elderly French men and women found that those with the lowest flavonoid intakes had a risk of developing dementia over the next five years that was 50% higher than those with the highest intakes. Although scientists are interested in the potential of flavonoids to



protect the aging brain, it is not yet clear how flavonoid consumption affects neurodegenerative disease risk in humans.

#### Resveratrol:

Caloric restriction is known to extend the lifespans of a number of species, including mammals. In yeast, caloric restriction stimulates the activity of an enzyme known as Sirt2. Providing resveratrol to yeast increased Sir2 activity in the absence of caloric restriction and extended the replicative lifespan of yeast by 70%. Resveratrol feeding also extended the lifespans of worms (*C. elegans*) and fruit flies (*D. melanogaster*) by a similar mechanism. Moreover, one study showed that resveratrol extended the lifespan of mice on a high-calorie diet, but effects in higher animals are not known. Although resveratrol increased the activity of the homologous human enzyme (Sirt1) in the test tube, it is not known whether resveratrol can extend the human lifespan. Moreover, the resveratrol concentrations required to increase human Sirt1 activity were considerably higher than concentrations that have been measured in human plasma after oral consumption.

*The Linus Pauling Institute provides dietary and lifestyle recommendations for generally healthy individuals interested in optimum health and prevention of chronic diseases such as cardiovascular diseases (heart disease and stroke), diabetes, cancer, and osteoporosis.*