Supporting Healthy Aging

There is substantial scientific evidence suggesting that generous intakes of a variety of nutrients can help protect vision, lung function, neurological function and cognitive ability, skin and muscle integrity, and immune function in the aging population.

"At the beginning of the 20th century, fewer than half of all Americans lived past 65 years; now over 80 percent have this expectation. Presently, 13 of every 100 Americans are age 65 years or older; this proportion will increase to 20 of every 100 by the year 2030." (Bales & Wang, 2004)

NUTRITIONAL SHORTFALLS IN THE ELDERLY

"The percentage of older adults among the world's population continues to increase." While obesity is a problem for many, undernutrition "continues to be prevalent in approximately 25-40 percent of older adults worldwide." (Silver, 2009) Undernutrition is "associated with poor health outcomes—from inadequate diet quality and having micronutrient deficiencies, to loss of lean body and skeletal muscle mass... as well as inflammatory stress, compromised immune function, impaired wound healing, increased susceptibility to infections, impaired physical performance, functional dependencies, depression, and being homebound. Moreover, undernutrition reduces overall quality of life and is associated with increased mortality risk. Finally, undernutrition is a healthcare burden that continues to strain the economic resources of developing and developed countries.... Unfortunately, the most vulnerable older adults, i.e., older women, minorities, rural-living, and the poor are at greatest risk." (Silver, 2009) There is a need for more research on the benefit and cost of various strategies for improving nutrient intakes, body weight, and functionality in ways that are safe, clinically relevant, and cost-effective.

In Arizona, an extensive survey of the dietary habits of 1740 healthy adults over the age of 50 showed that more than 60 percent had deficient dietary intakes of vitamin D, vitamin E, folate, and calcium. Their intakes were not only below the *recommended* levels, but below the *average requirement*. In terms of dietary patterns, no more than 10 percent of the population met the Food Pyramid recommendations for grain or dairy products, and only about 50 percent met the daily recommendations for fruits and vegetables. (Foote, Giuliano, et al., 2000)

Researchers working in rural Iowa surveyed nutrient intakes of more than 400 elderly residents. All subjects were 79 years of age or older (average age 85) and were living in the community, not in an institution. More than half lived alone. "Eighty percent of subjects reported inadequate intakes of four or more nutrients." Folate, vitamin D, and calcium intakes were inadequate in most of this elderly population. "Multivitamin/mineral supplementation with additional calcium may be necessary for the old to achieve adequate nutrient intakes." (Marshall, Stumbo, et al., 2001)

AGE-RELATED MACULAR DEGENERATION

"Age-related macular degeneration (AMD) is a disease that affects the central vision. In the aging U.S. population, AMD is a major cause of visual impairment and blindness. The prevalence of AMD increases dramatically with age. Nearly 30 percent of Americans over the age of 75 have early signs of AMD and 7 percent have late-stage disease... This number is expected to triple with the increase in the aging population in the next 30 to 40 years." (Johnson, 2005) Low dietary and tissue levels of lutein and zeaxanthin are modifiable risk factors for AMD, as is obesity. These factors may be related in that obesity is associated with increased oxidative stress and increased inflammation. Also, dietary carotenoids are stored in body fat, which may act as a "sink" and thereby reduce the amount of lutein and zeaxanthin potentially available for the eye. (Johnson, 2005)

"Age-related macular degeneration (AMD) is a leading cause of blindness. Epidemiologic reports suggest that intake of foods rich in lutein protects against AMD. Lutein and its structural isomer, zeaxanthin, selectively accumulate in the retina and are particularly dense in the macular region where they are main components of macular pigment. Lutein functions as an antioxidant and blue light filter and may protect the macula from light-initiated oxidative damage. Oxidative stress is high in the eye because of repeated exposure to light and the high rate of oxidative metabolism in the retina," and this oxidative damage may play a role in the development of AMD. (Johnson, Chung, et al., 2008) Docosahexaenoic aid (DHA), a key omega-3 fatty acid, is also found in the retina and is a component of photoreceptors which are constantly being renewed and thus in need of a constant supply of DHA. (Johnson, Chung, et al., 2008)

"Age-related macular degeneration (AMD) is a burden to the elderly population, and its consequences are increasing because treatment options are limited. Prevention remains the best approach for decreasing the impact of this leading cause of blindness. Knowledge about modifiable factors related to AMD has increased considerably during the past decade, including most notably cigarette smoking, nutritional factors, obesity, and lipid levels." (Seddon, Gensler et al., 2004) One recently discovered risk factor for AMD is having an elevated level of C-reactive protein (CRP), a marker of systemic inflammation. (Seddon, Gensler, et al., 2004)

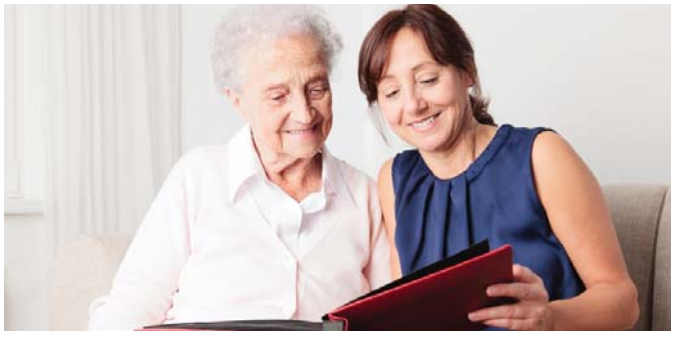
...It is estimated that if the 8 million individuals in the U.S. who are at high risk of developing advanced AMD received the AREDS formulation, more than 300,000 of the 1 million persons expected to develop advanced AMD... would avoid it...

AREDS is an 11-year, multicenter trial involving more than 3,600 people who had evidence of AMD when they entered the trial. Participants were assigned to one of four groups, with each group receiving antioxidant supplements, zinc supplements, both, or a placebo. The antioxidant supplement included 500 mg vitamin C, 400 IU vitamin E, and 15 mg beta-carotene. The zinc supplement included 80 mg zinc and 2 mg copper. The participants that received both the antioxidant and the zinc supplements were significantly protected from development of advanced AMD.

The researchers suggested that people over the age of 55 should have an eye exam including dilation of the eyes to evaluate their risk of developing advanced AMD. People at risk of AMD "should consider taking a supplement of antioxidants plus zinc such as that used in this study." (AREDS-8, 2001) However, the authors noted that supplementation with beta-carotene is not advised for smokers.

The protective effect of the AREDS antioxidant supplement was modest, but could have substantial population impact. "With this modest therapeutic effect of the AREDS formulation, the potential effect on public health of the disease burden of AMD is considerable. It is estimated that if the 8 million individuals in the United States who are at high risk of developing advanced AMD received the AREDS formulation, more than 300,000 of the 1 million persons expected to develop advanced AMD... would avoid it, and its associated vision loss, during the next 5 years." (Chew, Lindblad, et al., 2009)

The National Eye Institute at the National Institutes of Health (NIH) is currently undertaking an additional, multi-center, randomized clinical trial, called AREDS2, to assess the effects of supplementation with high levels of lutein and zeaxanthin and/or supplementation with the marine omega-3 fatty acids EPA and DHA on the risk of progression of AMD. The study is also intended to determine whether decreased levels of zinc or the omission of beta-carotene modifies the effect of the original AREDS formulation. (NIH National Eye Institute, 2010)



CATARACTS

Vitamin C is 60 times more concentrated in the lens of the eye than in blood plasma, and other antioxidants are also concentrated in the lens. Opacity of the lens of the eye is one of the first signals that cataracts are developing. Cataracts are a major cause of blindness throughout the world, and antioxidants are believed to play a role in protecting against cataracts. Scientists have suggested that the adequate provision of antioxidant vitamins might delay cataract development sufficiently to decrease the number of cataract operations in the United States by one-half. (Taylor, 1992)

"Age-related cataracts are an important public health problem globally and remain a leading cause of blindness worldwide, with surgical extractions increasing the medical care costs in many developed countries. The oxidation of proteins or lipids within the lens is known to be associated with the formation of age-related cataracts." (Yoshida, Takashima, et al., 2007) In a prospective study of more than 30,000 Japanese residents ages 45 to 64 years, researchers studied the association between vitamin C intake and five-year risk of cataract. Diagnosis of cataracts and extraction of cataracts during a five-year period were significantly lower in men and women with higher intakes of vitamin C. (Yoshida, Takashima, et al., 2007)

In the Age-Related Eye Disease Study (AREDS) sponsored by NIH, a high-dose antioxidant formulation showed no significant effect on the progression of cataracts. However, most of the participants in the study were using a national-brand multivitamin in addition to the study treatment, and subsequent analysis showed that use of the multivitamin provided significant protection against cataracts. (Milton, Sperduto, et al., 2006)

In the Blue Mountains Eye Study in Australia, the effect of antioxidant intake on the 10-year development

of age-related cataracts was studied in 2464 subjects. "Increasing vitamin C consumption was associated with a significantly reduced 10-year risk of incident nuclear cataract... A similar but nonsignificant trend was observed for vitamins A and E and zinc." The authors conclude that the study "provides evidence of long-term beneficial association between antioxidants, mainly vitamin C (either alone or in combination with other antioxidants), and nuclear cataract development, a well-known biological marker of aging." (Tan, Mitchell, et al., 2008)

In the Nutrition and Vision Project (NVP), the development of cataracts in almost 500 women over the age of 50 was studied in relation to their usual nutrient intake over a period of 13 to15 years prior to the visual exam. The prevalence of lens opacities was lower in women with higher intakes of vitamin C and in women who had used a vitamin C supplement for 10 years or more. "Results from the NVP provide further evidence that antioxidant nutrients are associated with risk of age-related lens opacification. Total vitamin C intake from diet and supplements was associated with a lower prevalence of nuclear opalescence." (Jacques, Chylack, et al., 2001) Vitamin C intake in the lowest quintile was as high as 140 mg per day, which is almost double the RDA for women. Yet the risk of lens opacity decreased in each quintile as vitamin C intake went up to 180, 240, and even 360 mg per day. It has been estimated that tissues in the human eye become saturated with vitamin C at intakes in the range of 200 to 300 mg per day. Vitamin E, lutein, and zeaxanthin also had protective effects, but these were not clearly independent of the vitamin C effect, since women with a high vitamin C intake tended to have higher intakes of the other nutrients as well. (Jacques, Chylack, et al., 2001)

Among residents of Beaver Dam, Wisconsin, the risk of developing a cataract over a period of five years was 60 percent lower in people who had used multivitamins or a supplement containing vitamin C or vitamin E for more than 10 years, compared to people who did not use such supplements. Use of supplements for a shorter period of time did not appear to have a protective effect. "Measured differences in lifestyle between supplement users and non-users did not influence these associations, nor did variations in diet as measured in a random subsample." (Mares-Perlman, Lyle, et al., 2000)

ANTIOXIDANTS AND THE LUNGS

"Reduced pulmonary function is an important predictor of mortality in the general population." (Schunemann, Grant, et al., 2001) Factors that affect pulmonary function are not completely understood, but exposure to excessive oxidation is believed to have a damaging effect. "Vitamin C and vitamin E are powerful antioxidants found in the lung where they protect against oxidative damage. Although vitamin E is predominantly membrane bound, there is a close interaction between vitamins C and E, because vitamin C not only functions directly as an antioxidant, but it also recycles the antioxidant capacity of oxidized vitamin E." (Schunemann, Grant, et al., 2001) Vitamin A and the carotenoids also have anti-inflammatory and antioxidant activity and play a role. "These compounds have been thought to protect against development of lung cancer and other respiratory illnesses." In a study of more than 1,600 adults in western New York, researchers examined the association between serum levels of these vitamins and lung function.

Lung function was found to improve as blood levels of the antioxidant vitamins increased, with the strongest impact being associated with vitamin E and beta-cryptoxanthin. (Schunemann, Grant, et al., 2001)

In a British study of lung function in 178 men and women 70 to 96 years of age who had respiratory symptoms, researchers found that for every extra milligram of vitamin E in the diet, there was an improvement in performance on two tests of lung function. (Dow, Tracey, et al., 1996) In another study of more than 2,600 people in the area of Nottingham, England, higher dietary intakes of vitamin C and vitamin E were associated with improved lung function. (Britton, Pavord, et al., 1995)

Exposure to ozone can cause inflammation in the lung and potentially damage it. In a study involving 31 healthy adults, researchers gave the participants 250 mg of vitamin C, 50 IU of vitamin E, and 12 ounces of a vegetable cocktail or a placebo for a period of two weeks. For the two weeks of the study and the week before it started, the participants followed a vitamin C-restricted diet. The subjects were then exposed to ozone for a period of two hours and lung function was tested. The ozone caused an inflammatory response in all of the groups, but those supplemented with antioxidants had less damage to lung function compared to the placebo group. This study suggests that antioxidant supplementation may be "a safe and effective strategy with which to decrease pulmonary function responses to this common air pollutant." (Samet, Hatch, et al., 2001)

NUTRITION AND BRAIN FUNCTION

In a long-term study of more than 3,000 Japanese-American men over 70 years of age living in Hawaii, researchers found that the use of vitamin C and vitamin E supplements significantly reduced the risk of dementia. In those without dementia, use of vitamin C or vitamin E supplements was associated with improved cognitive function. (Masaki, Losonczy, et al., 2000)

In a longitudinal study of aging, researchers from the University of New Mexico School of Medicine measured cognitive function in 137 people ages 66 to 90. Higher intakes of vitamin C, thiamin, riboflavin, niacin, and folate were correlated with better performance on various tests of cognitive performance. "Use of self-selected vitamin supplements was associated with better performance on a difficult visuospatial test and an abstraction test." (La Rue, Koehler, et al., 1997)

"Although severe vitamin deficiencies and congenital defects are rare, milder subclinical vitamin deficiencies are not uncommon in the elderly. Interest is increasing in learning the extent to which these mild, reversible deficiencies contribute to some decline in cognitive function in the later years of life." (Selhub, Bagley, et al., 2000) It is well established that deficiencies of the B vitamins involved in the single-carbon cycle have severe effects on brain function that can result in depression, dementia, and other disorders. Results of some studies "support the possibility that poor vitamin status is partially responsible for the cognitive decline seen in some elderly persons." (Selhub, Bagley, et al., 2000)

In an Australian study of the effects of a multivitamin supplement compared to a placebo in 50 healthy older men, eight weeks of supplementation reduced the overall score on a test for depression, anxiety and stress, and resulted in improvements in alertness and general daily functioning; the supplement included vitamins at levels above officially recommended intakes, as well as minerals, antioxidants, and herbal extracts. (Harris, Kirk, et al., 2011)

According to the authors of a study on Alzheimer's disease, "there is evidence that medications or vitamins that increase the levels of brain catecholamines and protect against oxidative damage may reduce the neuronal damage and slow the progression of Alzheimer's disease." (Sano, Ernesto, et al., 1997) They conducted a randomized, double-blind, multicenter study involving 341 patients. During the two-year study, patients received a monoamine oxidase inhibitor called selegiline, 2000 IU per day of vitamin E, both treatments, or a placebo. The researchers reported that treatment with vitamin E or with selegiline delayed progression of the disease, including "delays in the deterioration of the performance of activities of daily living and the need for care." (Sano, Ernesto, et al., 1997)

There is evidence to suggest that oxidative stress plays a role in the development of Alzheimer's disease, and there is clear evidence of oxidative damage in the brains of patients with the disease. A clinical trial of vitamin E and selegiline in patients with moderate Alzheimer's disease showed that these treatments slowed the rate of functional decline to a significant degree. The results raise the question whether vitamin E might also delay the decline in patients with milder cases of Alzheimer's disease, "and whether it may prevent dementia in elderly individuals who are minimally or not yet cognitively impaired." (Grundman, 2000) The Alzheimer's Disease Cooperative Study has initiated an additional trial to determine whether vitamin E can prevent or delay development of Alzheimer's disease in patients with mild cognitive impairment. (Grundman, 2000)

AGING OF THE SKIN

"During the course of skin aging, both skin function and appearance are affected. Changes in appearance are the most visible signs of aging and include wrinkles, irregular pigmentation, sagging...," thinning, and loss of elasticity. "Such changes in appearance have substantial negative effects on self-esteem and social wellbeing. Furthermore, appearance was shown to be an indicator of overall health status, and it has been shown that 'looking old for one's age' is associated with increased risk of mortality." (Cosgrove, Franco, et al., 2007) Researchers examined the association between nutrient intakes from foods (not from supplements) and the appearance of skin aging in more than 4,000 women who were over the age of 40 and who were included in the First National Health and Nutrition Examination Survey. Higher intakes of vitamin C and linoleic acid and lower intakes of fats and carbohydrates are associated with a lower appearance of skin aging, according to the authors. "Perhaps appealing benefits such as reducing skin-aging appearance may motivate healthy eating, and new campaigns to promote healthy dietary behaviors could consider this issue." (Cosgrove, Franco, et al., 2007)

Both animal and human studies have shown that supplementation with carotenoids, such as beta-carotene, lycopene, and lutein, can significantly reduce UV-light induced erythema (i.e., sun burn) of the skin. (Heinrich, Gartner, et al., 2003; McArdle, Rhodes, et al., 2004; Stahl, Heinrich, et al., 2000) Supplementation with tomato-based products increases lycopene, phytofluene, and phytoene levels in human serum and protects against UV-light-induced erythema. (Aust, Stahl, et al., 2005) This does not appear to be due to a sunscreen effect, as these carotenoids do not filter out UV light the way sunscreens do, but instead involves an antioxidant effect. UV light generates free radicals in the skin which trigger an inflammatory response that leads to erythema. Carotenoids that are taken orally are absorbed and subsequently deposited in the subcutaneous layers of the skin, where researchers believe they quench the UV-generated free radicals, in turn preventing the inflammatory response that leads to erythema.

SELENIUM AND MUSCLE STRENGTH IN THE ELDERLY

"Aging is characterized by the loss of muscle strength, which in turn increases the risk of falls, hospitalization, disability, and mortality." (Lauretani, Semba, et al., 2007) Oxidative damage to muscle proteins, lipids, and DNA increases with age. Selenium plays an important role in muscle function, and selenium-containing enzymes help protect muscle cells (and other cells) from oxidative damage. The authors examined the association between muscle weakness and marginal selenium status in almost 900 men and women, age 65 and over, who were dwelling in the community in Tuscany, Italy. People in the lowest quartile of plasma selenium were at higher risk of poor hip strength, knee strength, and grip strength. (Lauretani, Semba, et al., 2007)

VITAMIN D AND FALLS

There is evidence that adequate vitamin D supplementation reduces the risk of falling in the elderly. A meta-analysis of eight randomized controlled trials found that supplementation with 700 to 1000 IU per day of vitamin D or achieving a serum level of at least 60 nmol/L of 25-hydroxyvitamin D reduced the risk of falling by about 20 percent. Lower levels of supplementation (200 to 600 IU per day) and lower serum levels of vitamin D were not protective. (Bischoff-Ferrari, Dawson-Hughes, et al., 2009)

CALCIUM, VITAMIN D, AND BONE DENSITY

Calcium and vitamin D are both essential to achieving maximum bone density and slowing bone loss during aging. Most people fail to get protective amounts of both nutrients, and supplementation even late in life can have a positive effect. The Surgeon General's report in 2004 observed: "It is never too late for prevention, as even older individuals with poor bone health can improve their bone health status through appropriate exercise and calcium and vitamin D intake." (Department of Health and Human Services, 2004)

NUTRITION AND IMMUNE FUNCTION

It is likely that improved nutrition could enhance resistance to infectious disease in the elderly. If immune function could be improved, the impact on quality of life and on the nation's health care costs could be substantial.

"In comparison with the general population, older Americans are twice as likely to visit the doctor and 3 times more likely to be hospitalized; their average hospital stays are twice as long, and they consume twice the number of prescription drugs." (High, 2001) Infection is one of the most common causes of sickness in the elderly, and older people are two to ten times more likely to die of infections than younger

adults. A review of clinical trials on nutritional interventions supports "use of a daily multivitamin or trace-mineral supplement that includes zinc (elemental zinc, >20 mg/day) and selenium (100 mcg/day), with additional vitamin E to achieve a daily dosage of 200 mg/day." (High, 2001) The article adds that health care providers should be aware of common drug/nutrient interactions, since the elderly are often heavy users of medications.

In a Boston study of 88 healthy people 65 years of age or more, vitamin E supplementation was found to improve some measures of immune function. Researchers at the USDA Human Nutrition Research Center on Aging indicated that the best responses were observed in people given 200 mg of vitamin E per day, versus 60 or 800 mg. (Meydani, Meydani, et al., 1997)

A study of vitamin E supplementation and respiratory infections in more than 600 elderly individuals in nursing homes reported a lower incidence of upper respiratory infections, including the common cold, in the group that was given 200 IU of vitamin E daily. Everyone in the trial (the placebo group as well as the vitamin E group) also received a supplement providing half the RDA for numerous vitamins and minerals throughout the trial. (Meydani, Leka, et al., 2004) In the course of this study, it was observed that more than 30 percent of the subjects had low serum zinc levels at the beginning of the study and also after a year of follow-up, despite the fact that they were given a supplement providing 50 percent of the RDA of essential vitamins and minerals, including zinc, during the trial. Compared to people with low zinc levels, the elderly with normal zinc levels had a lower incidence of pneumonia, fewer prescriptions for antibiotics, a shorter duration of pneumonia, fewer days of antibiotic use, and a lower rate of all-cause mortality. Zinc is a required cofactor for more than 300 enzymes and is "essential to the function of all highly-proliferating cells in the human body, especially the immune system." (Meydani, Barnett, et al., 2007)

A study by Dr. Ananda Prasad and coworkers also reported that zinc supplementation decreased the number of infections over a period of one year, compared to the placebo group, in people age 55 and over. (Prasad, Beck, et al., 2007)

In a review, Dr. Simin Meydani and other authors suggested that elderly people with low serum zinc levels might benefit from zinc supplementation. "Based on our careful review of the literature and given the upper safe limit of zinc, a dose of 30 mg elemental zinc per day might be adequate to improve immune function and to reduce the risk of infections." (Barnett, Hamer, et al., 2010)

A study of immune function in elderly residents of New Jersey showed that taking a daily multivitamin for one year resulted in a stronger immune system and higher blood levels of several vitamins. The researchers suggested that current recommendations for some micronutrients may be too low to support optimal immune function in healthy, independently living older adults. (Bogden, Bendich, et al., 1994)

In a two-year study in a nursing home in France, residents were given zinc and selenium *or* vitamin C, vitamin E, and beta-carotene; *or* all five nutrients; *or* a placebo. People who were supplemented with the min-

erals, with or without the vitamins, had significantly fewer respiratory infections and urogenital infections over the two-year period. (Girodon, Lombard, et al., 1997)

NUTRITIONAL SUPPLEMENTS SHOULD BE PROVIDED IN NURSING HOMES

Elderly persons residing in nursing homes may be particularly at risk of unrecognized inadequacies of vitamins and minerals because of difficulties in feeding and because they are already suffering from numerous diseases or disorders. While other nutritional problems observed in nursing homes may be difficult to remedy, micronutrient deficiencies can be avoided through inexpensive, safe supplementation. Dr. Connie Bales of the Duke University Medical Center emphasizes that "the benefits could be remarkable, with the potential for improvements in a number of vital functions, including but not limited to cognitive ability and immunocompetence." (Bales, 1995)

A study of Veterans Administration nursing homes found that 88 percent of the residents had dietary intakes below 50 percent of the RDA for three or more nutrients. Researchers observed that "essential nutrient inadequacies can lead to adverse effects on nearly all organ systems and can contribute to many of the physical and mental complications commonly seen in nursing home residents." (Rudman, Abbasi, et al., 1995) They urge nursing home administrators to assure that residents unable to feed themselves receive a multivitamin/mineral supplement daily to alleviate complications related to nutrient inadequacy such as the following:

- Inadequate intakes of calcium, phosphorus, and vitamin D predispose to bone loss and fractures, both of which are common in the nursing home population.
- Deficient intakes of copper, iron, folate, or vitamin B-12 can cause or contribute to anemia, which is present in 50 percent of residents.
- Deficiency in zinc predisposes to dermatitis, slow wound healing, and altered mental status.
- Pyridoxine (B-6) deficiency can cause or intensify anemia and affect the incidence of convulsions.
- Low intakes of thiamin or niacin can predispose to abnormal behavior or dementia.

While it is assumed that the RDAs apply to the nursing home population, some studies have shown that higher-than-RDA levels of some nutrients are required by some patients. "It would appear that in some nursing home patients, changes in absorption, transport, storage, metabolism and excretion are such that an intake at the RDA level does not result in a normal blood level." (Drinka & Goodwin, 1991) Further research is warranted, but in the meantime "it would appear prudent to place all nursing home residents on an inexpensive multiple vitamin containing the RDA and to consider placing the more debilitated residents on generic supplements containing several times the RDA of water soluble vitamins." (Drinka & Goodwin, 1991)

In an Australian study of the effectiveness of a multivitamin in 92 residents of an aged care facility, taking the multivitamin for six months was found to increase serum levels of vitamin D, vitamin B-12 and folate, compared to levels in residents given a placebo. Also, there was "an increase in bone quality and a trend toward a 63% lower rate of falls." (Grieger, Nowson, et al., 2009)

Dr. Bales has concluded, "While only a small proportion of the elderly population actually resides in nursing homes at any point in time, it is likely that many of us will pass that way at some point in our lives... Perhaps by moving forward with a common sense approach [supplementation] for dealing with remediable nutritional problems in the facilities where they occur, we could be doing ourselves and/or our loved ones a nutritional favor—in advance." (Bales, 1995)

Bottom Line

The elderly are at risk for nutrient inadequacy, and that inadequacy can have a specific negative impact on many aspects of their health. Antioxidant supplements have been shown to have a positive impact on eye diseases, lung function, skin, and cognitive dysfunction. Adequate nutritional status also affects the condition of the skin and supports muscle function. Calcium and vitamin D supplements can have a powerful impact on bone health, and it is never too late to benefit from improved intakes of these nutrients. Vitamin D can also reduce the risk of falls in older people. Vitamin and mineral supplements have been shown in some studies to improve immune function in the elderly. Low zinc intakes are associated with an increase risk of infections, including pneumonia. Generous intakes of some individual nutrients such as vitamin E have had a positive effect in decreasing upper respiratory infections. Some experts believe it makes sense to encourage the elderly to use multivitamin and mineral supplements. Some have also advocated providing a multivitamin and mineral product to the elderly in nursing homes, as a matter of policy, to avoid risking the consequences of inadequate intakes.

REFERENCES

AREDS-8. (2001). A randomized, placebo-controlled, clinical trial of high-dose supplementation with vitamins C and E, beta carotene, and zinc for age-related macular degeneration and vision loss: AREDS report no. 8. *Arch Ophthalmol, 119*(10), 1417-1436.

Aust, O., Stahl, W., Sies, H., Tronnier, H., et al. (2005). Supplementation with tomato-based products increases lycopene, phytofluene, and phytoene levels in human serum and protects against UV-light-induced erythema. *Int J Vitam Nutr Res, 75*(1), 54-60.

Bales, C. (1995). Micronutrient deficiencies in nursing homes: should clinical intervention await a research consensus? *J Am Coll Nutr, 14*(6), 563-564.

Bales, C., & Wang, Y. (2004). Global Graying and Nutritional Trends in the New Millenium. In C. Bales & C. Ritchie (Eds.), *Handbook of Clinical Nutrition and Aging*. Totowa, N.J.: Humana Press.

Barnett, J. B., Hamer, D. H., & Meydani, S. N. (2010). Low zinc status: a new risk factor for pneumonia in the elderly? *Nutr Rev, 68*(1), 30-37.

Bischoff-Ferrari, H. A., Dawson-Hughes, B., Staehelin, H. B., Orav, J. E., et al. (2009). Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials. *BMJ, 339*, b3692.

Bogden, J. D., Bendich, A., Kemp, F. W., Bruening, K. S., et al. (1994). Daily micronutrient supplements enhance delayed-hypersensitivity skin test responses in older people. *Am J Clin Nutr, 60*(3), 437-447.

Britton, J. R., Pavord, I. D., Richards, K. A., Knox, A. J., et al. (1995). Dietary antioxidant vitamin intake and lung function in the general population. *Am J Respir Crit Care Med, 151*(5), 1383-1387.

Chew, E. Y., Lindblad, A. S., & Clemons, T. (2009). Summary results and recommendations from the age-related eye disease study. *Arch Ophthalmol, 127*(12), 1678-1679.

Cosgrove, M. C., Franco, O. H., Granger, S. P., Murray, P. G., et al. (2007). Dietary nutrient intakes and skin-aging appearance among middle-aged American women. *Am J Clin Nutr, 86*(4), 1225-1231.

Department of Health and Human Services. (2004). *Bone health and osteoporosis: A report of the Surgeon General*.

Dow, L., Tracey, M., Villar, A., Coggon, D., et al. (1996). Does dietary intake of vitamins C and E influence lung function in older people? *Am J Respir Crit Care Med, 154*(5), 1401-1404.

Drinka, P. J., & Goodwin, J. S. (1991). Prevalence and consequences of vitamin deficiency in the nursing home: a critical review. *J Am Geriatr Soc, 39*(10), 1008-1017.

Foote, J. A., Giuliano, A. R., & Harris, R. B. (2000). Older adults need guidance to meet nutritional recommendations. *J Am Coll Nutr, 19*(5), 628-640.

Girodon, F., Lombard, M., Galan, P., Brunet-Lecomte, P., et al. (1997). Effect of micronutrient supplementation on infection in institutionalized elderly subjects: a controlled trial. *Ann Nutr Metab, 41*(2), 98-107.

Grieger, J. A., Nowson, C. A., Jarman, H. F., Malon, R., et al. (2009). Multivitamin supplementation improves nutritional status and bone quality in aged care residents. *Eur J Clin Nutr, 63*(4), 558-565.

Grundman, M. (2000). Vitamin E and Alzheimer disease: the basis for additional clinical trials. *Am J Clin Nutr, 71*(2), 630S-636S.

Harris, E., Kirk, J., Rowsell, R., Vitetta, L., et al. (2011). The effect of multivitamin supplementation on mood and stress in healthy older men. *Hum Psychopharmacol, 26*(8), 560-567.

Heinrich, U., Gartner, C., Wiebusch, M., Eichler, O., et al. (2003). Supplementation with beta-carotene or a similar amount of mixed carotenoids protects humans from UV-induced erythema. *J Nutr, 133*(1), 98-101.

High, K. P. (2001). Nutritional strategies to boost immunity and prevent infection in elderly individuals. *Clin Infect Dis, 33*(11), 1892-1900.

Jacques, P. F., Chylack, L. T., Jr., Hankinson, S. E., Khu, P. M., et al. (2001). Long-term nutrient intake and early age-related nuclear lens opacities. *Arch Ophthalmol, 119*(7), 1009-1019.

Johnson, E. J. (2005). Obesity, lutein metabolism, and age-related macular degeneration: a web of connections. *Nutr Rev, 63*(1), 9-15.

Johnson, E. J., Chung, H. Y., Caldarella, S. M., & Snodderly, D. M. (2008). The influence of supplemental lutein and docosahexaenoic acid on serum, lipoproteins, and macular pigmentation. *Am J Clin Nutr, 87*(5), 1521-1529.

La Rue, A., Koehler, K. M., Wayne, S. J., Chiulli, S. J., et al. (1997). Nutritional status and cognitive functioning in a normally aging sample: a 6-y reassessment. *Am J Clin Nutr, 65*(1), 20-29.

Lauretani, F., Semba, R. D., Bandinelli, S., Ray, A. L., et al. (2007). Association of low plasma selenium concentrations with poor muscle strength in older community-dwelling adults: the InCHIANTI Study. *Am J Clin Nutr, 86*(2), 347-352.

Mares-Perlman, J. A., Lyle, B. J., Klein, R., Fisher, A. I., et al. (2000). Vitamin supplement use and incident cataracts in a population-based study. *Arch Ophthalmol, 118*(11), 1556-1563.

Marshall, T. A., Stumbo, P. J., Warren, J. J., & Xie, X. J. (2001). Inadequate nutrient intakes are common and are associated with low diet variety in rural, community-dwelling elderly. *J Nutr, 131*(8), 2192-2196.

Masaki, K. H., Losonczy, K. G., Izmirlian, G., Foley, D. J., et al. (2000). Association of vitamin E and C supplement use with cognitive function and dementia in elderly men. *Neurology, 54*(6), 1265-1272.

McArdle, F., Rhodes, L. E., Parslew, R. A., Close, G. L., et al. (2004). Effects of oral vitamin E and beta-carotene supplementation on ultraviolet radiation-induced oxidative stress in human skin. *Am J Clin Nutr, 80*(5), 1270-1275.

Meydani, S. N., Barnett, J. B., Dallal, G. E., Fine, B. C., et al. (2007). Serum zinc and pneumonia in nursing home elderly. *Am J Clin Nutr, 86*(4), 1167-1173.

Meydani, S. N., Leka, L. S., Fine, B. C., Dallal, G. E., et al. (2004). Vitamin E and respiratory tract infections in elderly nursing home residents: a randomized controlled trial. *J Am Med Assn, 292*(7), 828-836.

Meydani, S. N., Meydani, M., Blumberg, J. B., Leka, L. S., et al. (1997). Vitamin E supplementation and in vivo immune response in healthy elderly subjects. A randomized controlled trial. *J Am Med Assn, 277*(17), 1380-1386.

Milton, R. C., Sperduto, R. D., Clemons, T. E., & Ferris, F. L., 3rd. (2006). Centrum use and progression of age-related cataract in the Age-Related Eye Disease Study: a propensity score approach. AREDS report No. 21. *Ophthalmology, 113*(8), 1264-1270.

NIH National Eye Institute. Age-related eye disease study (AREDS 2). Retrieved May 18, 2010, from http://www.areds2.org/

Prasad, A. S., Beck, F. W., Bao, B., Fitzgerald, J. T., et al. (2007). Zinc supplementation decreases incidence of infections in the elderly: effect of zinc on generation of cytokines and oxidative stress. *Am J Clin Nutr, 85*(3), 837-844.

Rudman, D., Abbasi, A. A., Isaacson, K., & Karpiuk, E. (1995). Observations on the nutrient intakes of eating-dependent nursing home residents: underutilization of micronutrient supplements. *J Am Coll Nutr, 14*(6), 604-613.

Samet, J. M., Hatch, G. E., Horstman, D., Steck-Scott, S., et al. (2001). Effect of antioxidant supplementation on ozone-induced lung injury in human subjects. *Am J Respir Crit Care Med, 164*(5), 819-825.

Sano, M., Ernesto, C., Thomas, R. G., Klauber, M. R., et al. (1997). A controlled trial of selegiline, alpha-tocopherol, or both as treatment for Alzheimer's disease. The Alzheimer's Disease Cooperative Study. *N Engl J Med, 336*(17), 1216-1222.

Schunemann, H. J., Grant, B. J., Freudenheim, J. L., Muti, P., et al. (2001). The relation of serum levels of antioxidant vitamins C and E, retinol and carotenoids with pulmonary function in the general population. *Am J Respir Crit Care Med, 163*(5), 1246-1255.

Seddon, J. M., Gensler, G., Milton, R. C., Klein, M. L., et al. (2004). Association between C-reactive protein and age-related macular degeneration. *J Am Med Assn, 291*(6), 704-710.

Selhub, J., Bagley, L. C., Miller, J., & Rosenberg, I. H. (2000). B vitamins, homocysteine, and neurocognitive function in the elderly. *Am J Clin Nutr, 71*(2), 614S-620S.

Silver, H. J. (2009). Oral strategies to supplement older adults' dietary intakes: comparing the evidence. *Nutr Rev, 67*(1), 21-31.

Stahl, W., Heinrich, U., Jungmann, H., Sies, H., et al. (2000). Carotenoids and carotenoids plus vitamin E protect against ultraviolet light-induced erythema in humans. *Am J Clin Nutr, 71*(3), 795-798.

Tan, A. G., Mitchell, P., Flood, V. M., Burlutsky, G., et al. (2008). Antioxidant nutrient intake and the long-term incidence of age-related cataract: the Blue Mountains Eye Study. *Am J Clin Nutr, 87*(6), 1899-1905.

Taylor, A. (1992). Role of nutrients in delaying cataracts. *Ann NY Acad Sci, 669*, 111-123; discussion 123-114.

Yoshida, M., Takashima, Y., Inoue, M., Iwasaki, M., et al. (2007). Prospective study showing that dietary vitamin C reduced the risk of age-related cataracts in a middle-aged Japanese population. *Eur J Nutr, 46*(2), 118-124.