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Nutrient Supplementation in the Elderly

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ABSTRACT

Populations both in the US and worldwide are aging. It is projected that by the year 2030 the population of Americans over 65 will increase to 70 million, more than twice their number in 1998. About one-third of elderly over the age of 65 have debilitating chronic health conditions that greatly impede their activities. Age-associated chronic diseases are believed to be associated with free radicals and the imbalance in antioxidant and oxidative stress contributes to development of several chronic health conditions. Diet and nutrients can have great impact in the health status of elderly. Several factors may contributor to the inadequate consumption of nutrients in elderly, including an inability to chew food adequately, polypharmacy, living alone and limited income. Low intake of energy and several micronutrients are common among the elderly. Although overt deficiency of nutrients among the elderly is not common, a recent study showed that while elderly consume more fat, the total energy intake is low among the elderly. Inadequate intake of antioxidant nutrients such as vitamin E in elderly may contribute to the development of chronic health problems. Intake of higher than normal RDA levels of vitamin E for long periods of time has been shown to reduce the risk of many degenerative diseases, such as cardiovascular diseases(CVD) and cancer, and improve immune response in elderly. High intake of other antioxidants is also associated with reduced risk chronic diseases. Dietary antioxidants are abundant in fruits and vegetables. However, due to variety of factors, the elderly may not be able to receive these and other micronutrients through diet. Therefore, supplemental intake of micronutrients in the form of multi vitamins/minerals and/or specific micronutrients is a more practical approach to the maintenance of health status in the elderly. (*J Community Nutrition* 2(1) : 5~11, 2000)

KEY WORDS : age, nutrition, vitamin E, disease, supplement.

Introduction

Aging is a complex biological process often accompanied by various socioeconomic changes that have a great impact on the nutritional status and needs of the elderly individual. The population of elderly over 65 years of age is rising worldwide. The number of older Americans has increased by 3.2 million in the last decade. It has been projected that by the year 2030, there will be about 70 million elderly over the age of 65 years in US, more than twice the number in 1998(Fowles 1999). Factors such as improved health care and diet, vaccination, and new drugs have contributed to the prevention of infant mortality and to the growth of the elderly population in the US and other countries. With aging, however, the incidence of disability increases due to development of chronic conditions that require medical attention and assistance from family or social organizations. In the United States, over 1/3 of elderly people are limited by chronic conditions and are unable to carry on major activities. Recent data indicates that (Alaimo et al. 1998) more than 50% of eld-

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erly over the age of 65 suffer from one form of disability, and 33% of elderly suffer from at least one type of severe disability. Hypertension, heart disease, arthritis, hearing impairments, orthopedic impairments, cataracts and diabetes are the most common health problems that pose difficulties for elderly in carrying out activities of daily living(ADL). Therefore, it is anticipated that the number of elderly people with disabilities will increase concomitantly with the rise in the elderly population to more than 30 million in the US by 2010. Therefore, prevention of age-related decline in mobility and reducing the prevalence of chronic disease are important factors for elderly is independence and ability to carry out ADL. Preventive strategies are considered to be the most practical and cost effective way to reduce prevalence of disability in the elderly.

Free radicals and oxidative stress are believed to play important roles in the biology of aging and in many age-associated degenerative diseases. A shift in the antioxidant/prooxidant balance to higher free radical generation, and an increase of oxidative stress over time leads to dysregulation of cellular function, is the basis for the free radical theory of aging. Genetic, environmental, and lifestyle factors play important roles in the rate of changes in this balance and, thus, on the rates of aging and development of age-associated diseases. Decreased food intake, a sedentary lifestyle, and reduced energy expenditure in older adults together are the risk factors for malnutrition, especially for protein and micronutrients and may further contribute to the decline of bodily functions and development of chronic age-associated degenerative diseases. Living alone, limited income, physical disablity, and use of several drugs at a time are additional factors that may contribute to the reduced food intake in elderly people. The survey of 40,000 subjects in the third National Health and Nutrition Examination Survey(NHANES Ⅲ) in the US included a survey of about 5,000 elderly subjects in groups of 60－69 years, 70－79 years, and 80+ years (DHHS 1994 : National Center for Health Statistics 1994). This survey for the first time provided a cross-sectional health and nutrition status in the aging US population(Burt & Harris 1994). The report highlighted that the median intake of total energy in the elderly individuals in general is lower than the recommended 2,300kcal for men and 1,900kcal for women(Marwick 1997). Caloric intake from fat by the elderly is higher than 30% of the recommended daily allowance(RDA). Low intake of fat is widely recognized to be important for reducing the risks of obesity, coronary heart disease and certain forms of cancer. The survey also found that elderly people consumed enough vitamins C and A, micronutrients important for maintenance of a healthy life, to meet RDA levels. However, elderly Americans appear not to be consuming sufficient calcium to meet the recommended 800 mg/day level, which is important for bone health and reducing the risk of osteoporosis and bone fracture. The survey also reported that intake of vitamin E is lower than the current recommended level, which is 15mg/day. Vitamin E is an important antioxidant to prevent lipid peroxidation and maintain cellular membrane integrity. The NHANES Ⅲ study clearly demonstrated that food insufficiency exists among the elderly in the US and that its prevalence is significantly associated with the income status(Alaimo et al. 1998). In addition to inadequate food intake and malnutrition due to income limitations, other factors, including physical disability, inability to chew and polypharmacy, may contribute to the risk of inadequate consumption of food in elderly.

Nutrition Interventions

Many age-associated diseases are nutrition related. Chronic conditions may also increase needs for certain nutrients due to changes in absorption and metabolism. A growing body of data suggests that generation of free radicals and oxidative stress is a major player in the aging process and age-associated diseases. Therefore, elimination of free radicals and reducing oxidative stress, and increasing anti-oxidant defenses, is considered a potential way to reduce both the rate of aging and the risk of chronic disease. Traditionally, nutrition has been recognized as an important factor in the modulation of disease and longevity. However, only caloric restriction in animal models has been shown to be effective in slowing down the aging process. Caloric restriction has been demonstrated to be an effective dietary intervention to reduce oxidative stress, improve the antioxidant defense system and extend both median and maximum life spans in several animal models(Weindruch 1996). Caloric restriction has also been shown to retard the decline of bodily functions, such as those of the immune and neuronal systems(Fernandes et al. 1997 ; Weindruch 1992) and to delay the onset of age-related diseases such as cancer, diabetes and cataracts(Novelli et al. 1998 ; Taylor et al. 1995 ; Weindruch 1992). Caloric restriction in rodent models has been shown to increase longevity when caloric restriction is introduced at any time after the animal has matured(Yu 1995). Evidence suggests that the mechanism of action of dietary restriction is partly through reduction of oxidative stress and an increase in endogenous antioxidant enzymes defense system. The restriction of caloric intake by 30–40% in humans, however, appears to be difficult, as it would require drastic behavioral modifications. This type of restriction is virtually impractical at present, except in clinical settings, and is thus not a plausible option for increasing longevity or reducing disease risk in a population.

Reduction of oxidative stress and increase in antioxidant capacity appear to be important factors for increasing longevity in dietary restriction models and are in accordance with free radical theory of aging. Therefore, it was proposed that increasing antioxidant status by feeding animals with natural or synthetic antioxidants would reduce oxidative stress and thus contribute to the longevity. These attempts, however, were not as successful(Comfort 1971 ; Harman 1968 ; Harman 1980 ; Kohn 1971) as the results obtained from dietary restriction paradigms. However, a relatively recent study demonstrated that a mixture of several dietary antioxidants if begun early in life might extend longevity of animals(Bexlepkin et al. 1996). Extension of this observation to humans, i.e., long-term supplementation of a large number of human subjects with antioxidants to examine longevity, would be of great value. It would be very interesting to prove that high antioxidant capacity and low oxidative stress is a major contributing factor in the increased longevity of human populations in those countries where the life expectancy according to demographical data is longer than others. Changing and balancing diet without drastic reductions of caloric intake in combination with change in lifestyle, such as exercising, abstaining from smoking and moderating alcohol intake, together with maintenance of ideal body weight, are the factors for upkeep of health and reduced risk of chronic diseases.

Nutrition and Age-Related Chronic Diseases

Several studies have reported that supplemental intake of antioxidant vitamins such as

vitamins E and C is associated with reduced risk of age-associated chronic diseases such as cardiovascular disease, certain forms of cancer, cataracts and cognitive impairment which in turn might have contributed to the longevity and growth of the elderly population. Thus it would be of great value to examine the potential role of supplemental intake of antioxidants vitamins in relation to the increased life expectancy observed in the recent decades in the US population and other parts of the world.

Dietary components of foods containing antioxidant activity such as vitamin E or specific forms of fatty acids such as(n-3) polyunsaturated fatty acids(PUFA) have received particular attention due to their potential role in modulating the oxidative stress associated with aging and age-related chronic diseases. Several studies have found a potential role of these dietary components in the modulation of immune and inflammatory systems, which play important roles in prevention of infectious and inflammatory diseases in the elderly and in the reduction of risk for chronic disease such as cancer and cardiovascular disease, the leading causes of morbidity and mortality in US and many other Western societies.

Earlier, we(Meydani et al. 1986) reported that supplementation of 24 month old mice with 500 ppm dietary vitamin E improved several indices of the immune system to levels comparable to those of young animals. Supplementation of aged mice with this vitamin also increased clearance of influenza virus from the lung compared to animals supplemented with other antioxidants such as melathonine, glutathione or strawberry extract which contains a high level of flavonoids with antioxidant activity(Han et al. 2000). In a double-blind, placebo-controlled study(Meydani et al. 1990 ; Meydani et al. 1997), reported that supplementation of elderly subjects with vitamin E for a short(1 month) or long(4.5 month) period of time also improved several in vitro and in vivo indices of immune response. The optimal immune response was observed with 200IU of vitamin E/day in the long-term study. It is worth noting that 200IU of vitamin E reported to be the optimal level for reducing plasma F_2-isoprostane, a reliable index of lipid peroxidation(Dillon et al. 1998). Improving the immune response in the elderly may result in a lower incidence of infections, which are prevalent among the elderly, and thus may contribute to a longer and healthier life.

Scores of observational and clinical trials have also indicated that a high intake or high plasma level of vitamin E is associated with a low risk of cardiovascular disease(Meydani 1995 ; Meydani 1998). Several lines of evidence indicated that supplemental level of vitamin E may prevent cardiovascular disease by reducing susceptibility of LDL to oxidation(Jialal et al. 1995), reducing expression of chemokines and adhesion molecule expression and monocyte adhesion(Wu et al. 1999), decreasing smooth muscle proliferation(Azzi et al. 1995), improving vessel relaxation(Green et al. 1998 ; Keaney et al. 1993 ; Neunteufl et al. 1998), and decreasing platelet aggregation(Steiner 1999).

Fish oil derived(n-3) PUFA has been also reported to contribute to cardiovascular health through its anti-inflammatory properties(Glomset 1985 ; Kinsella et al. 1990). Consumption of fish-derived(n-3) PUFA does not reduce LDL cholesterol levels, but reduces plasma levels of very low density lipoprotein(VLDL) cholesterol, and has been consistently shown to reduce plasma triglyceride levels(Harris & Conner 1980). Further(n-3), PUFA have been shown to decrease platelet aggregation(Hansen et al. 1993 ; Winther et al. 1993) and high blood pressure(Morris et al. 1993), which, in part, supports the epidemiologic findings on the association of reduced risk of CVD with fish or fish oil consumption(Glomset 1985 ; Kinsella et al. 1990). In addition, the anti-in-

flammatory characteristics of these fatty acids contribute significantly to their antiatherogenic properties. This latter effect of fish-derived(n-3) PUFA is mainly attributed to their modulation of prostanoid, leukotriene, and cytokine production, all of which participate in atherogenesis.

However, supplementation with(n-3) PUFA from fish oil has been reported to suppress immune response(Meydani et al. 1991 ; Meydani et al. 1993), which hampers enthusiasm for the use of fish-derived(n-3) PUFA for its benefits on CVD. However, the latter concern could be addressed by including supplemental intake of vitamin E along with fish oil supplements. In a recent study, we found that supplementing elderly with(n-3) PUFA of fish oil in combination with vitamin E, while maintaining anti-inflammatory properties of(n-3) PUFA, did not reduce immune indices in elderly(Wu et al. 2000).

Several studies have indicated that consumption of fruits and vegetables is associated with lower risk of cancer(Ames et al. 1993). Antioxidant vitamins or non-nutritive polyphenols present in fruits and vegetables may contribute to their effect on reducing the cancer risk. Reduction of oxidative stress and prevention of DNA damages and mutation have been suggested as some of the mechanisms by which these compounds may affect cancer reduction. They may also inhibit tumor growth by suppressing angiogenesis, the formation of new blood vessels from existing ones. We have recently made in vitro observations that angiogenesis induced by oxidative stress is inhibited by supplementing the microvascular endothelial cells with vitamin E or green tea catechins, polyphenols with antioxidant activity. Vitamin E supplementation and regular consumption of green tea both have been reported to be associated with reduced risk of cancer(Attar 1992 ; Das 1994 ; Fleshner et al. 1999 ; Mukhtar et al. 1994 ; Nakachi et al. 1998 ; Shklar & Schwartz 1996). Green tea catechins have been shown to be effective in reducing angiogenesis in vivo animal models(Cao & Cao 1999). Our in vitro studies have indicated that reductions of IL-8 production and disassociation of VE-cadherin with intracellular catinin are some of the mechanisms by which these antioxidants modulate angiogenesis.

Conclusion

Free radicals have been accepted to be involved in both aging and the pathology of many age-associated diseases. This concept is strongly supported by evidence resulting from dietary restriction interventions in animal models, modulation of enzymatic and dietary antioxidant status and observational and clinical interventions on the association antioxidants and oxidative stress indices with chronic diseases in humans. The contribution of dietary or supplemental antioxidants during the past decades to the increase of life expectancy and growth of elderly population is not known. However, evidence has indicated that adopting a healthy lifestyle, which includes eating a balanced diet, being physically active and abstaining from smoking, as well as availability of better health care, most likely contributes significantly to increased life expectancy. Emerging data from epidemiological and clinical studies also emphasize the importance of micronutrients in increasing vigor of several bodily functions such as immune and cardiovascular in the elderly. In addition, supplemental intake of antioxidants and other micronutrients appears to be important in preventing or delaying the onset of several age-associated chronic diseases such as CVD, cancer, dementia, and infections, the major cause of morbidity and mortality among the elderly. In com-

parison to medical care and drug treatments, nutritional interventions in the elderly are more feasible to be implemented cost-effectively.

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