

# Patterns of Food and Nutrient Intake Among the Elderly

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## Introduction

The elderly, as a population group are growing in total numbers and in proportion to the rest of the population. As the baby boom generation moves into older age, the Bureau of the Census projects that the percentage of the population above age 65 will approach 20%. In efforts to control the high cost of health care, there has been a growing interest in health promotion and disease prevention, and, as a central component of this, in the diet and nutritional status of the elderly. As a high risk group for nutrition and health problems, their diet is of interest to those making policy, planning programs and delivering services. As a large and growing market, their consumption patterns and dietary requirements are also of interest to the food industry. A great deal of research has been completed in the past 10 years. However, the largest growing group of elders are those over age 85 and few large data sets currently include information on those over age 74. The demographics also show large increases in minority elderly, groups for which data are only recently becoming available.

Examinations of the diets of the elderly are important for several reasons: 1) identification of specific nutrients which may be consumed inadequately by the elderly population, 2) identification of sub-groups which are most at risk of low intake of specific nutrients or food groups, 3) identification of dietary patterns which place the elderly at nutritional risk and 4) understanding of relationships between nutrient intake or dietary patterns and disease, disability or mortality.

At the USDA Human Nutrition Research Center on Aging at Tufts University, we have been exploring these questions, most recently with three large cross sectional data sets: 1) the HNRCA Nutritional Status Survey—conducted between 1981-1983 with 223 men and 447 women aged 60-89 years, using 3 day records; 2) the Framingham Heart Study—dietary data were collected between 1988 and 1989 with 375 men and 598 women, aged 67-95 using the Willett food frequency questionnaire; and 3) the Normative Aging Study—data were collected between 1987 and 1991 with 1134 men aged 43 through 85 years, again using the Willett questionnaire.

## Identification of low nutrient intakes

Energy and nutrient intakes of elderly groups are frequently reported to be low compared with the RDA. In a 1989 review article, Horwath concluded that intakes of vitamin B6, folate, calcium, zinc, potassium, and magnesium were most likely to be inadequate (1). In the nutritional status survey, we also found that intakes of energy, vitamin B6, vitamin D, zinc, calcium and magnesium were low in relation to the 1989 RDA. It is important to note that an earlier analysis of these data, using the 1980 RDA (and a different nutrient database), showed dramatically higher proportions with low levels of folate, vitamin B6 and vitamin B12 intake. This may be partly due to a greater completeness of nutrient data for the latter analysis but mostly it is because the RDA for these B vitamins was lowered in 1989. In a review article of recent studies on nutrient requirements in the elderly, currently in press, Russell and Suter (2) question the wisdom of lowering the RDA for these nutrients. The current RDAs do not distinguish among adults aged 51+. New information, including some I will discuss in a moment, suggests that the RDA need further refinement by age categories and that for many nutrients, they should be higher for the elderly.

## **Sub-groups at risk: Age**

Most studies of intake among the elderly have looked at total nutrient intakes, and they have usually found lower intakes with older age. Upon closer examination, however, some studies, including papers by Block, Mares-Perlman, Slesinger and Cronin, show improvements in diet quality with age, once total energy intake is controlled (3-6). In a sample of men from the Normative Aging Study, we saw strong positive relationships of age with energy adjusted nutrient intake, including complex carbohydrates, dietary fiber, carotene, vitamin C, vitamin E and with number of servings of fruit per day. In the Framingham Heart Study, men's intakes included more vitamin A and iron with age, after control for energy and women's intakes included more retinol and vitamin D. Older men consumed relatively larger amounts of cereals, fruits and vegetables; while women consumed more milk. Age was also related to lower consumption of snack foods, pasta and pizza. Other studies, including those by Davis, Cronin and Mares-Perlman, have also shown lower consumption of snacks (7), carbonated beverages (6) and alcohol (4) with age. Overall, it appears that with age, there is a tendency to lower total food intake, but to better dietary patterns.

## **Sub-groups at risk: Income, education and living alone**

Certain situational factors place the elderly at risk of poor intakes. It is commonly assumed that low income and low education are important risk factors. However, surprisingly few studies have examined these relationships. Nutrients which have been reported to be vulnerable to low income include vitamin C, vitamin B6, folate, iron, and zinc (8,9). Davis et al. (10) also found low dietary diversity with low income and Cronin et al. found lower consumption of beef, non-fat milk and fruits.

In our own work, we have found that education level is frequently related to food and nutrient intake. In the Normative Aging Study, those with College level education consumed greater energy controlled amounts of several key nutrients, including dietary fiber, carotene, vitamin C and calcium. Their intakes of green and orange as well as other vegetables were also significantly greater than those with less education. In Framingham, education was related to several nutrients from dietary intake alone for women but not men, and to total intakes for both men and women, reflecting greater supplement use with education level as well as improved intakes.

Another important factor is living or eating alone. This variable has been examined with several data sets, including national level data, by Davis (7,10) and Murphy (11). In our analysis of the Normative Aging Study, we also found that men living alone were at risk of low intakes, particularly for fruits and vegetables and associated nutrients, including vitamin C, carotene and dietary fiber.

## **Dietary Patterns**

Of course, there is great variation in dietary patterns within any group of elderly. We examined the diets of the Boston Nutritional Status Survey participants using cluster analysis and found four major intake groups: those dominated by alcohol; by fruits, cereals and milk; by breads and poultry; and by meat and potatoes. The group of subjects consuming the milk, cereal and fruit pattern had diets which were significantly higher in many nutrients, including vitamins A, C, riboflavin, folate, vitamin B6, calcium and magnesium. These differences in dietary intake also appeared to translate to nutritional status. This group had higher blood levels of riboflavin, vitamin B12 and folate than other groups (12). From these data it appears that consumption of breakfast cereals, fruit, and milk seems to protect nutrient adequacy. Other studies have also found that eating breakfast, and particularly including breakfast cereals in the diet is protective (10,11). In addition to the Nutritional Status Survey, we have analyzed the Normative Aging Study and the Framingham data using Cluster analysis and have found similar groupings despite differing study populations and data collection methods.

## Diet and Health and Disease Prevention

At the USDA Human Nutrition Research Center on Aging there is considerable activity in the investigation of nutrients in relation to aging and health. Vitamins of major current interest include the anti-oxidants vitamin C, vitamin E and  $\beta$ -carotene, which have been found to be protective for several conditions including heart disease, cataract and immune function; folate and associated B vitamins, important to vascular disease; vitamin A, potentially important in cancer prevention; and vitamins D and K, important to bone status.

The relationship between vitamin E and immune function with aging is the focus of work by Simin Meydani and Jeff Blumberg at the HNRCA. They have found dramatic effects in indicators of immune response—including Delayed Type Hypersensitivity skin tests (DTH), an indicator of overall cellular immune response, lymphocyte proliferation and Interleukin 2 levels—with vitamin E supplementation. Recent studies have also found strong protective effects of vitamin E supplementation against heart disease. We have less of an understanding of varying effects with dietary levels.

Folate is increasingly receiving attention as an important nutrient in health maintenance. It has recently been shown to be protective against neural tube defects in pregnancy. There is also accumulating evidence for its role in prevention of vascular disease, through its relationship with homocysteine, a metabolite which requires folate as well as vitamins B6 and B12 for its utilization. In the presence of deficiency, or low levels of these nutrients, particularly folate, it accumulates in the blood and appears to do considerable damage. Jacob Selhub and Paul Jacques have found a strong relationship between dietary folate and homocysteine levels. (13).

One potential complication in studying folate is that there are several forms in food. Currently, the tables reflect only total folate. Jacob Selhub has recently developed a new method of food analysis which allows the identification of the various forms and has found that the profile for example, for liver is different than for lima beans, and these are both very different than for egg yolk. This raises a question about bioavailability. Are all forms equal in their translation to folate status and how does this affect our evaluation of mixed diets? Metabolic studies will be needed to arrive at detailed conclusions. We have done some very preliminary investigation of actual diets with the Framingham population. Holding total folate intake constant, we find that individuals who receive their folate dominantly from supplements have the highest blood levels, followed by breakfast cereals, citrus fruits, vegetables and bread. This initial comparison has not been rigorously tested and has not accounted for other folate antagonists in the diet, but suggests that differences in folate form may have differing bioavailabilities.

Vitamin D is another nutrient of concern. Holick and colleagues have shown that the ability to formulate vitamin D in the skin declines with age (14). Many homebound elderly have little sun exposure and therefore are at risk for low vitamin D status and associated decline in bone status. Little is available on dietary status of vitamin D due to the lack of complete values in food tables.

Finally, there is growing interest in vitamin K, which has also been found to be important to bone mineralization. Due to the very limited availability of information on vitamin K in foods, Jim Sadowski and Sarah Booth, at the HNRCA, have been actively analyzing foods for a revised provisional table (15). They have found that most dietary vitamin K is from vegetables and oils, although it is widely distributed in foods in small amounts. There is great variation among vegetables, with leafy greens contributing the highest levels; and within vegetables, with outer sections generally containing more vitamin K than inner sections. Vegetable oils have considerably more vitamin K than animal fats. Canola, and soybean oil, used commonly in salad dressings, are particularly good sources.

## Conclusions

In conclusion, many elderly do appear to have low nutrient intakes, particularly for total energy and for folate, vitamins B6, B12, D, calcium, magnesium and zinc. Energy intake tends to decrease with age and, in association with that, many absolute nutrient intakes decrease as well. On the other hand, there is evidence that dietary patterns, and nutrients in relation to energy level, may actually improve with age. Much remains to be learned with respect to nutrient requirements of the elderly. There do exist variations in dietary pattern within the elderly as a group, which can be identified across studies. Those consuming relatively more energy from cereals, fruits and milk appear to have more adequate nutrient intakes and blood levels for several nutrients. With recent advances in research, we are beginning to gain more understanding of the importance of specific nutrients to health and disease prevention. Of key current interest are folate, which appears to be protective against high homocysteine levels and associated vascular disease; vitamins D and K, which protect bone status and antioxidants which protect against declines in immune function, and against the development of heart disease and cancer.

The theme of this conference is "Moving into the next century". With the changing demographics, we know that the elderly will form a larger proportion of the population. We also know that a growing proportion of these will be from minority groups, with Hispanics the most rapidly growing segment. Our limited current understanding of nutrition and aging suggests that anti-oxidant nutrients, B vitamins, vitamin D and vitamin K will be central to many areas of relevant research in the future. This has direct implications for databases, as the food tables are still incomplete for many of these nutrients, particularly for foods consumed by minority populations.

With a new method to analyze levels of various forms of food folate, much research will be needed to understand their relevance. The accumulating data on carotenoids, especially the new tables prepared by Gary Beecher and Joanne Holden at the USDA Nutrient Composition Laboratory, and on vitamin K developed by Jim Sadowski, Sarah Booth and others, will also be very important to future research on diet and health of the elderly.

Future database needs important to studies of nutrition and aging include the completion and refinement of data for these and other nutrients as well as non-nutrients in food as we increasingly recognize their roles in health maintenance and disease prevention.

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