Factors Affecting Nutrient Intake of the Elderly. By Jon Weimer. Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 769.

Abstract

The rapid expansion of the population age 60 and older has a number of economic implications. The people in this group, about 18 percent of the population, account for about 30 percent of all health care expenditures. They use hospitals at nearly three times the rate of younger persons, average seven to eight medical visits per year, and occupy the majority of nursing residence beds. Providing information on the relationship of socio-economic and other factors to nutrient intake is basic to improving the health and well-being of the elderly. This exploratory investigation provides estimates of the effects of selected characteristics of the household and its constituents on individual nutrient consumption of elderly heads of households. Formal education was positively related to nutrient consumption. The elderly who live in households with income below 130 percent of the poverty level tended to have lower nutrient intakes than those elderly in households with higher incomes. Blacks, urbanites, and Southerners generally consumed less of the selected nutrients. Neither participation in the Food Stamp Program nor receipt of surplus foods was a significant factor in nutrient intake of elderly individuals. Possible nutrition interventions focus on targeted audiences and programs.

Keywords: Elderly, nutrient intake, dietary status, nutrition.

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Summary

While the diets of the U.S. elderly population in general are deficient in a number of essential vitamins and minerals, the diets of certain subgroups of the elderly, namely the poor, those with little education, blacks, and women, are much more deficient than the rest.

The report, based on data from USDA's 1989-91 Continuing Survey of Food Intake by Individuals, correlates socio-economic status of the elderly (age 60 and over) with their dietary consumption of calories and 11 nutrients: fat, protein, niacin, calcium, phosphorus, magnesium, iron, zinc, and vitamins E, C, and B-6.

Diets of the more highly educated elderly and the higher income elderly were less deficient in nutrients than the diets of the other elderly. The more highly educated elderly consumed more of vitamins E, C, and B-6, niacin, calcium, phosphorus, and magnesium than the other elderly. The lower income elderly (those whose income is below 130 percent of the poverty level) consumed significantly less calories and the 11 nutrients except vitamin E, calcium, and iron.

Elderly blacks generally consumed less calories, fat, vitamins E and B-6, niacin, calcium, phosphorus, magnesium, iron, and zinc than elderly whites. Hispanic elderly consumed more protein than elderly whites.

The elderly who lived in the northeastern part of the Nation seemed to have a more nutrient-rich diet than those who lived elsewhere. These elderly consumed more calories, fat, vitamins C and B-6, niacin, phosphorus, and magnesium than elderly residents in other parts of the country.

The diets of the elderly who lived in central cities were generally more deficient in iron than the diets of the elderly who resided in either suburban or rural areas.

Diets of elderly women were generally more deficient in all the nutrients, except for vitamin C, than the diets of elderly men.

The elderly who reported that a doctor had told them they had diabetes, heart disease, or cancer consumed significantly less fat and calories than other elderly. This relationship may reflect more awareness of the diet-health link by these elderly, but disease-associated emotional or physical disability may also have been a contributing factor.

Whether the elderly ate alone or in a group seemed to have no effect on the nutritional composition of their diets.

Participation in USDA's Food Stamp Program had no significant effect on the elderly's nutrient consumption. Participation in USDA's Commodity Supplemental Food Program (which distributes surplus foods to supplement the diets of certain at-risk populations, including the elderly) likewise had no significant effect on the elderly's nutrient consumption.

The elderly population is expected to reach nearly a quarter of the total U.S. population by the year 2030. Adequate nutritional intake is essential for optimal physical and mental activity and can help maintain the health and emotional independence of older Americans, a national priority for Federal health policy. The elderly who would benefit most from food and nutrition intervention seem to be those with less education and lower income, women, and blacks.

Factors Affecting Nutrient Intake of the Elderly

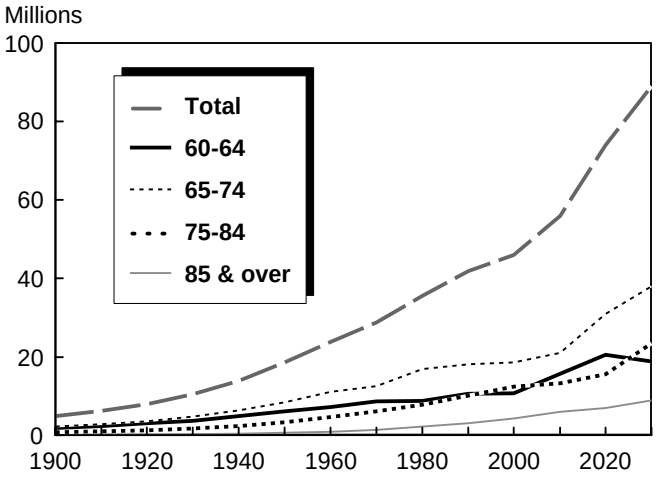
Jon Weimer

Introduction

The segment of the population aged 60 and older is rapidly expanding, a growth expected to continue through the 21st century. The number of Americans age 60 and older grew from about 5 million in 1900 to approximately 42 million in 1990, a figure that is expected to more than double by the year 2030 (fig. 1). The proportion of people 60 years of age and older has also increased, from 6.4 to 18.4 percent of the U.S. population during 1900-90, a share that is expected to expand to almost one-fourth of the population by 2030.

The elderly account for about 30 percent of all health care expenditures in the United States. They also use hospitals at nearly three times the rate of younger people, average seven to eight medical visits per year, and occupy the majority of nursing residence beds (American Dietetic Association, 1993). The maintenance of health and functional independence of older persons is a national priority, as identified in the U.S. Department of Health and Human Services' (DHHS) report *Healthy People 2000* (1992).

Figure 1
Total population in the older ages, 1900-2030



Source: U.S. Department of Agriculture, Economic Research Service, based on data from U.S. Department of Commerce, Bureau of the Census.

Poor nutritional status is a primary concern for the elderly. Nutritionally inadequate diets can contribute to or exacerbate chronic and acute diseases, hasten the development of degenerative diseases associated with aging, and delay recovery from illness (Posner, 1979).

There is increased interest in nutritious diets as a vital component of the health care delivery system for the elderly (Blumberg, 1986). The need to assist those elderly requiring specific dietary management through the health care delivery system in non-institutionalized residences vulnerable to nutritional deficiencies is becoming increasingly important.

The nutritional status of elderly individuals and the quantitative effect of individual, dietary, and environmental factors are inadequately understood, at best. Investigators have stressed the difficulties inherent in determining the scope of nutritional problems among the aged, the intricacies of studying the requirements for nutrients as age progresses, and an inadequate understanding of nutrient requirements among the aging (Blumberg, 1994; Bowman and Rosenberg, 1982; and Horwath, 1991). However, if one accepts the premise that current methods of assessing dietary intake are adequate and that nutritional deficiency develops from inadequate nutrient intake leading to clinically recognizable deficiency, then prefatory investigations into factors associated with nutrient deficiencies are warranted. This approach is consistent with the statement by the National Academy of Science's Food and Nutrition Board in 1974, which stated that "...the further habitual intake falls below the Recommended Dietary Allowance standard for a particular nutrient and the longer the low intake continues, the greater the risk of deficiency."

The purpose of this report is to provide estimates of the effects of a number of selected characteristics of households and their members on nutrient intake of the elderly. A number of studies have analyzed the influence of socio-economic characteristics on nutrient consumption by the elderly, but many of these

have been limited to localized areas, confined to small groups selected for a variety of specialized situations (for example, nursing homes), and have involved primarily tabular analyses (Betts and Crase, 1986; Bianchetti and others, 1990; Goodwin, 1989; Harill and others, 1976; and Zylstra and others, 1995). This report reflects an exploratory investigation and expands knowledge of the relative importance of selected correlates of nutrient intakes among elderly heads of households.

The Sample and Database

Physically and functionally, aging occurs at markedly different rates among individuals, so any age criterion for classification of "elderly" must be somewhat arbitrary. The age stratum 60 years of age and older is frequently used (Posner, 1979) and will be used in this report. Sixty years is the minimum age for a person to be eligible to participate in the large-scale nutrition-intervention program administered by the U.S. Department of Health and Human Services Administration on Aging.

The data used for this investigation were obtained from the U.S. Department of Agriculture's (USDA) 1989-91 Continuing Survey of Food Intake by Individuals (CSFII). The CSFII provides dietary data covering 3 consecutive days for individuals of all ages. The first day's data were collected in a personal in-home interview, using a 1-day dietary recall of food intake. The second and third days' data are from a 2-day dietary record kept by respondents. The amount of each nutrient in each food eaten was calculated, using the weight (in grams) of that food and the nutritive value of that food (per 100 grams) from USDA's Nutrient Data Base for Individual Intake Surveys. The database contains representative nutrient values, per 100 grams of the edible portion, for each of approximately 6,700 food items. Personal and household characteristics data such as income, race, and education were also collected. The analysis presented in this report is restricted to include only individuals 60 years of age or older who were nominal heads of their respective households and who reported 3 days of complete intake data. In households with both a female and male head of household, only the female's nutrient intake was considered. It was assumed that in these elderly households, the traditional role of the female as the primary decisionmaker in terms of food preparation and food shopping prevailed. Elderly individuals who were not nominal heads of households were excluded from this analysis. The intent was to focus on those elderly who purportedly had some autonomy in making their food choices. After eliminating cases with missing values, the final sample consisted of 1,566 observations (1,373 women, 193 men). The average age of these individuals was 71.

Model Specification and Variables

Comparison of Nutrient Levels to Standards

Twelve separate regression models were specified to explain nutrient intake, one for energy and one for each of the 11 indicator nutrients selected—protein, fat, vitamin E, vitamin C, niacin, vitamin B-6, calcium, phosphorus, magnesium, iron, and zinc. These nutrients have been shown in some studies to be below recommended standards for the elderly (for example, Goodwin, 1989; and Horwath, 1991). Preceding specification of the models, it is useful to compare absolute levels of nutrients with standards for intake to generally assess the well-being of this sample. Sample means of intakes as a percentage of the Recommended Dietary Allowance (RDA) are shown in table 1.[1] Average intakes fell below the RDA's for energy, vitamins E and B-6, calcium, magnesium, and zinc. The standard deviations of the various nutrient intakes observed during the 3-day period are large relative to the average intakes, reflecting the wide variation in intakes. As a consequence, nutrient intakes by some individuals appear to be quite low, even for nutrients with average intake above the RDA. For the women in this sample, over one-third had nutrient intake below the RDA standards for energy and each nutrient, with the exception of fat (for which no RDA standard exists). Over one-third of the men fell below the RDA standards for energy and each nutrient, except niacin and phosphorus (table 2). These results are consistent with those reported in previous studies (Goodwin, 1989; Harrill and others, 1976; Horwath, 1991; and Morley, 1986), which also show that, excluding vitamin C and iron consumed by women, consumption of those nutrients tends to be below RDA standards among elderly more so than among the nonelderly.

[1]RDA's, except for energy, are estimated to exceed the nutrient requirements of most healthy individuals. For energy, the recommendations (technically known as the Recommended Energy Allowance) represent the average needs of people. The term "RDA," however, as used in this report also refers to energy requirements.

Table 1—Mean nutrient intake of the elderly and comparison with 1989 Recommended Dietary Allowances[1]

Nutrient	Women		Men	
	Mean intake	Percent of recommended allowance	Mean intake	Percent of recommended allowance
Energy (kcal.)	1,345.3 ± 446.2[2]	70. 8	1,733 ± 588.1	75.3
Protein (gm.)	56.1 ± 18.9	112. 2	71.9 ± 24.7	114.1
Total fat (gm.)	50.6 ± 21.3	NA	67.8 ± 29.6	NA
Vitamin E (mg.)	6.4 ± 5.2	80.0	7.3 ± 5.5	73.0
Vitamin C (mg.)	87.9 ± 61.9	146.5	92.3 ± 79.2	153.8
Niacin (mg.)	16.4 ± 6.5	125.4	20.7 ± 8.0	138.0
Vitamin B-6 (mg.)	1.4 ± .7	87.5	1.7 ± .9	85.0
Calcium (mg.)	572.5 ± 291.9	71.5	693.1 ± 375.4	86.6
Phosphorus (mg.)	893.2 ± 322.3	111.6	1,127.1 ± 443.1	140.9
Magnesium (mg.)	212.6 ± 81.6	75.9	248.6 ± 99.3	88.8
Iron (mg.)	11.4 ± 6.1	114.0	13.9 ± 8.8	139.0
Zinc (mg.)	8.3 ± 4.4	69.2	10.2 ± 5.1	85.0

[1]Mean intakes calculated using the CSFII 1989-91 3-year household weights.
[2]Standard deviation.

Multiple Regression Analysis

The socio-economic characteristics of elderly individuals that influenced the intake of the nutrients were sex, race, educational attainment, and employment status of the head of the household. General household characteristics investigated included degree of urbanization, geographic region, socialization available, food stamp participation, and receipt of surplus commodity foods.

The statistical model used was:

$$Qi=a +b_1E_1 +b_2E_2 + b_3A_1 + b_4A_2 +b_5A_3 + b_6U_1 +b_7U_2 +b_8S +b_9 P+b_{10}F +b_{11}R_1 + b_{12}R_2 + b_{13}R_3 + b_{14}X +b_{15}Y + b_{16}C + b_{17}M +b_{18}N,$$

where:

Q_i=average quantity of the *i*th nutrient (*i*=1.....12) consumed per individual over a 3-day period;
E_o-E_2=educational attainment of head of household (high school, grade school, college);
A_o-A_3=region of the country (South, Northeast, Midwest, West);
U_o-U_2=degree of urbanization (suburban, central cities, non-metropolitan);
S=socialization available in household (two or more members, less);
P=income as percentage of poverty threshold (up to 130 percent, more);
F=receipt of food stamps in household (yes, no);
R_o-R_3=race of head of household (white, black, Hispanic, other);
X=sex of head of household (male, female);
Y=age of head of household (60 to 70 years of age, greater than 70);
C=receipt of USDA surplus food within past 3 months (yes, no);
M=employment of head of household (working, not working); and
N=sensitization to diet-health relationship.

Table 2—Percentage of elderly falling below 1989 Recommended Dietary Allowances for selected nutrients

Nutrient	*Women*	*Men*
Energy (kcal.)	89	83
Protein (gm.)	38	37
Vitamin E (mg.)	79	80
Vitamin C (mg.)	40	48
Niacin (mg.)	34	23
Vitamin B- 6 (mg.)	68	72
Calcium (mg.)	82	68
Phosphorus (mg.)	41	20
Magnesium (mg.)	83	86
Iron (mg.)	51	35
Zinc (mg.)	87	88

Note: Recommended Dietary Allowances are for adults 51 years of age and over.
Source: Elderly Heads of Household, Continuing Survey of Food Intakes By Individuals, 1989-91, U.S. Department of Agriculture.

Measuring Dietary Status

Several interrelated measures can be used to assess a population's dietary status. Dietary studies, such as this report, frequently define an adequate, nutritious diet as one fulfilling the Recommended Dietary Allowance (RDA). RDA's specify the levels of the average intake of nutrients essential for maintaining normal body functioning for a healthy population. Diets under 100 percent of the RDA's are associated with, but do not necessarily mean, deficiency. The RDA's, however, form the basis for establishing nutritional goals that can be met by following the recommended servings as depicted by the USDA Food Guide Pyramid. Recently, USDA developed a measure of overall diet quality, called the Healthy Eating Index (HEI), which reflects how well diets conform to the recommendations of the Dietary Guidelines and Food Guide Pyramid. As part of its continuing emphasis on conducting basic research to assess socio-demographic and economic factors affecting dietary status and trends in food and nutrient consumption, Economic Research Service researchers are also examining this summary index to discern the effects of various factors on individuals' diets and the effects of public interventions to improve the diets of Americans (see Variyam and others, 1998).

Zero-one dummy variables were used to determine the effect of all these possible explanatory variables. For education, region, degree of urbanization, and race, the initial class in each category was excluded to avoid singularity. The same statistical model was applied to each nutrient. There was no *a priori* reason to exclude a variable for any particular nutrient estimate. Table 3 shows a socio-economic profile of the respondents in this sample.

Results

Table 4 shows the relationship of nutrient intake of this elderly sample to specified explanatory variables. The R^2 values are low, but they are typical for this type of cross-sectional study. More attention should be paid to the significance of the estimated coefficients. Further discussion of the effects of each independent variable follows.

Table 3 — Profile of study's elderly respondents

Item	Data
Average age	71 years
Education:	
Grade school	49 percent
High school graduate	31 percent
Some college	20 percent
Region:	
Northeast	19 percent
Midwest	21 percent
West	18 percent
South	42 percent
Urbanization:	
Central cities	30 percent
Suburban	37 percent
Rural	33 percent
Households with two or more people	46 percent
Household income up to 130 percent of poverty threshold	51 percent
Households receiving food stamps	11 percent
Households receiving commodity food	15 percent
Race:	
Black	12 percent
Hispanic	5 percent
White	82 percent
Other	1 percent

Source: U.S. Department of Agriculture, Economic Research Service.

Education of Head of Household

Education of heads of households was directly associated with nutritional knowledge and a more balanced diet for individuals in the household. In households with only a male head, his educational level was used. In those households in which a female and male head resided, education of the female head served as a proxy for nutritional knowledge in the household. As mentioned earlier, the assumption was that in these households, the female would be the primary decision-maker who selected and prepared the food, a role more likely to be traditional in the elderly household than one headed by younger individuals. Consumption of most of the selected nutrients tended to be positively related to additional formal education, although these tendencies were statistically significant only for vitamins E and C, niacin, vitamin B-6, calcium, phosphorus, and magnesium (table 4).

Region

Early studies by Burk (1961) have shown that the demand for food varies by region and is influenced by weather and custom. The South, in particular, showed marked differences from other regions, in terms of different kinds and amounts of food consumed (Burk,

Table 4—Relationship of nutrient intake of elderly to explanatory variables[1]

Variable	*Energy (kcal.)*	*Protein (gm.)*	*Total fat (gm.)*	*Vitamin E (mg.)*	*Vitamin C (mg.)*	*Niacin (mg.)*	*Vitamin B-6 (mg.)*	*Calcium (mg.)*	*Phosphorus (mg.)*	*Magnesium (mg.)*	*Iron (mg.)*	*Zinc (mg.)*
Non-high school graduate	-21.03 (28.49)[2]	-2.03 (1.21)	-0.07 (1.38)	-0.84 ** (.33)	-11.39** (3.89)	-1.06** (.41)	-0.12** (.04)	-41.50* (18.80)	-49.19* (20.89)	-10.35* (5.10)	-0.77 (.40)	-0.52 (.28)
Some college	21.79 (33.53)	-.17 (1.42)	-.55 (1.63)	.41 (.39)	12.96** (4.58)	-.10 (.49)	.05 (.05)	15.80 (22.13)	9.71 (24.60)	9.37 (6.01)	.61 (.47)	-.02 (.33)
Northeast	127.15** (32.74)	5.53** (1.39)	5.06** (1.59)	.25 (.38)	21.34 ** (4.47)	1.91** (.48)	.10 * (.05)	16.73 (21.61)	45.52 (24.01)	12.05 * (5.87)	.53 (.46)	.22 (.32)
Midwest	-20.05 (31.42)	.56 (1.33)	.57 (1.53)	-.45 (.36)	4.09 (4.29)	-.10 (.46)	-.03 (.05)	-39.97 * (20.73)	-31.81 (23.04)	5.29 (5.63)	-.26 (.44)	-.06 (.31)
West	-49.34 (34.30)	-2.03 (1.45)	-1.37 (1.67)	-.12 (.40)	5.62 (4.68)	-.51 (.50)	-.02 (.05)	-25.40 (22.63)	-33.72 (25.15)	3.73 (6.15)	-.22 (.48)	-.33 (.34)
Central cities	-46.17 (29.37)	.18 (1.24)	-2.27 (1.43)	-.59 (.34)	0 (4.00)	-.25 (.43)	-.05 (.05)	-3.91 (19.38)	-13.25 (21.53)	-6.37 (5.26)	-.89 * (.41)	-.30 (.29)
Rural	36.28 (28.42)	1.58 (1.20)	2.34 (1.38)	-.16 (.33)	-6.96 (3.88)	.08 (.41)	-.05 (.04)	-29.69 (18.76)	3.49 (20.84)	1.83 (5.09)	-.39 (.40)	-.18 (.28)
Socialization	23.29 (26.07)	1.38 (1.10)	.99 (1.27)	.19 (.30)	-3.81 (3.56	-.07 (.38)	.01 (.04)	-22.64 (17.20)	7.88 (19.11)	-.79 (4.67)	-.01 (.37)	.15 (.26
Poverty	-84.86 ** (28.74)	-3.89** (1.22)	-2.83 (1.40)	-.42 (.33)	-14.52** (3.92)	-1.08** (.42)	-.10* (.04)	-27.15 (18.96)	-49.04* (20.84)	-14.57** (5.15)	-.26 (.41)	-.66* (.28)
Food stamps	41.89 (41.25)	-1.03 (1.75)	1.27 (2.00)	.57 (.48)	-2.70 (5.63)	.20 (.60)	.01 (.06)	7.47 (27.22)	-10.07 (30.25)	1.48 (7.39)	.02 (.58)	-.38 (.40)
Black	-94.97** (38.59)	-1.66 (1.63)	-4.76** (1.88)	-1.27** (.44)	3.17 (5.27)	-1.39** (.56)	-.18** (.06)	-108.83** (25.47)	-107.68** (28.30)	-35.75** (6.91)	-1.25* (.55)	-.74* (.38)
Hispanic	1.04 (58.02)	5.67* (2.46)	-4.76 (1.88)	-.74 (.67)	-12.60 (7.92)	-.75 (.84)	-.06 (.09)	15.21 (38.28)	21.41 (42.54)	-18.00 (10.39)	-.14 (.82)	.67 (.57)
Other	207.06 (114.82)	7.68 (4.86)	6.74 (5.58)	-.26 (1.32)	-13.08 (15.67)	.89 (1.67)	-.07 (.18)	12.00 (75.77)	89.28 (84.19)	11.79 (20.57)	.53 (1.62)	.45 (1.12)
Gender	412.13** (36.64)	16.89** (1.55)	18.03** (1.78)	1.26** (.42)	6.43 (5.00)	4.53** (.53)	0.34 (.06)	128.89** (24.18)	255.88** (26.87)	42.11** (6.56)	2.85** (.52)	2.22** (.36)
Age	2.20 (24.65)	2.84** (1.04)	1.14 (1.20)	-.27 (.28)	.59 (3.36)	.64 (.36)	-.01 (.04)	2.03 (16.27)	23.16 (18.07)	6.68 (4.42)	-.35 (.35)	-.10 (.24)
Surplus food	-45.08 (35.71)	-.90 (1.51)	-2.19 (1.74)	-.24 (.41)	-1.25 (4.97)	-.46 (.52)	-.03 (.06)	5.70 (23.57)	-16.63 (26.19)	-6.72 (6.39)	-.44 (.50)	.17 (.35)
Employment	60.60 (40.69)	.11 (1.72)	3.68 (1.98)	.06 (.47)	-1.70 (5.55)	-.21 (.59)	-.06 (.06)	-36.08 (26.85)	-33.75 (29.84)	-7.56 (7.29)	-.57 (.57)	.16 (.40)
Sensitization	-52.85* (24.76)	-1.37 (1.05)	-2.72* (1.20)	-.01 (.29)	3.53 (3.38)	-.46 (.36)	0 (.04)	8.75 (16.33)	-7.48 (18.15)	1.59 (4.44)	-.38 (.35)	-.17 (.24)
R^2	.12	.12	.10	.04	.08	.09	.06	.05	.09	.09	.04	.04
F-ratio	12.11	11.39	9.79	3.15	7.28	8.73	5.63	4.40	8.73	8.29	3.79	3.98

[1]Regression coefficients estimated from single-equation unweighted regression model.

[2]Figures in parentheses are standard errors.

*=Significant at the 0.05 level.

**=Significant at the 0.01 level.

1961). In this investigation, elderly residents in the South consumed less calories, protein, fat, vitamins C and B-6, niacin, phosphorus, and magnesium than did the elderly in the Northeast (table 4). Nutrient intake levels for elderly residents from the South were not significantly different from those of elderly residents of the Midwest or West, although the Southern elderly did consume more calcium than the Midwestern elderly.

Degree of Urbanization

According to some investigators (Adrian and Daniel, 1976), degree of urbanization may reflect a composite effect of a number of different factors: potential for home food production, diversity of types of stores, differences in cultural and economic opportunities, and exposure to mass media. Regression coefficients showed lower consumption of most nutrients by urban elderly residents, although this was statistically significant only for iron.

Socialization

Some researchers have indicated that social interaction renders a positive influence on elderly nutritional intake (that is, the quality of diet for the elderly may be improved when the meal is shared with others rather than eaten alone). Conversely, then, these researchers believe that when the elderly eat alone, they experience a decrease in appetite and interest in food, resulting in poor nutritional intake. Some investigations have shown that social isolation may adversely affect dietary quality (Bianchetti and others, 1990; Murphy and others, 1990, 1993; and Zylstra and others, 1995), whereas others have shown no relationship between living arrangements and nutrient intake (Butler and others, 1985; Posner and others, 1987; and Ryan and Bower, 1989). This index of socialization has had a number of different operational definitions. Some researchers equate this variable with a perceived number of social contacts (Posner and others, 1987), frequent contact with friends or relatives (Butler and others, 1985) or living with spouse or others (Murphy and others, 1990; and Ryan and Bower, 1989). This study examined the effect of this variable on nutrient intake by looking at the size of the household in which the elderly individual resided. If the household contained other members besides the one individual, then the opportunity for meal socialization was present.

This factor was not significant for any of the indicator nutrients (table 4). The assumption that the mere existence of two or more members in a household can be equated with social activity at meal times is tenuous, and information such as source of meals (for example, at someone else's home), instances where meals were actually shared with household members, and presence of guests at meal time could probably serve as a better index of socialization. However, this information was unavailable. In this same context, it has also been suggested that strong attachment to the local community (that is, localization as described by McIntosh and Shifflett, 1984) and strong familial and religious commitments may provide social networks and support systems that enhance nutrient intake, information not available for this study.

Poverty

This factor reflects the amount of household income as a percentage of the appropriate poverty threshold and measures the ability of the individual's household to purchase a nutritionally adequate diet. Poverty, as reflected by this index, was related to significantly lower intake of all the selected nutrients except vitamin E, calcium, and iron.

Food Stamp Participation

The USDA's Food Stamp Program is a major form of nutrition intervention in the United States. Use of food stamps increases an individual's food expenditures. However, studies investigating factors affecting food consumption of subgroups other than the elderly have shown that little relationship exists between the receipt of food stamps and nutrient intake (Johnson and others, 1981; Lane, 1978; Price and others, 1978; West and others, 1978; West and Price, 1976; and Whitheld, 1982). Only a few studies have examined the effect of the Food Stamp Program on nutrient intake of the elderly. Although unquestionably the increase in resources that the Food Stamp Program provides recipients increases their ability to consume more food and attain a nutritionally adequate diet, mixed evidence indicates that elderly recipients actually eat more nutritional meals. Hama and Chern (1988) found that the Food Stamp Program had a significant effect on nutrient availability in households with elderly members. Akin and others (1985) also found a small but significant effect of food stamp participation on nutrient intake, particularly of those participants who also received Supplemental Security Income Program or Social Security Program benefits. However, other researchers (Butler and others, 1985; and Posner and others, 1987) found that food stamp participation had negligible effects on nutrient intake of the elderly.

Similarly, this investigation of the elderly found no significant relationship between food stamp participation and nutrient intake. No attempt was made to isolate a set of eligible nonparticipants in a statistically controlled setting and compare their nutrient intake with participants, an accepted procedure that may provide a more sensitive measure of the effect of food stamp participation on nutrient intake.

Race

Results of this study suggest that nutrient consumption of the elderly differs by race of individuals. Elderly blacks consumed less calories, total fat, vitamins E and B-6, niacin, calcium, phosphorus, magnesium, iron, and less zinc than whites. Hispanic elderly consumed more protein than elderly whites.

Age and Sex of Individual

The age range of these elderly heads of household was from 60 to 97. Individual intake of protein and niacin was significantly more for the "young" elderly (60-70 years of age) than it was for those over 70 years of age. Women's diets had a different nutrient composition than men's. The elderly women in this sample had significantly lower intakes of all nutrients except for vitamin C than the elderly men.

Receipt of Surplus Food

The USDA oversees a program called the Commodity Supplemental Food Program (CSFP), in which both funds and commodity foods are donated to States to supplement the diets of various target populations, including persons 60 years of age and over. The CSFP food packages are not intended to provide a complete diet, but rather are supplemental foods with nutrients that tend to be lacking in the diets of a target population. Previous studies of the CSFP's predecessor program (Commodity Distribution Program) indicated that this type of program had no significant effect on nutrient intake (Madden and Yoder, 1972; and Lane, 1978). This study too found that receipt of commodity foods was not a significant factor affecting nutrient intake.

Employment of Head of Household

It was assumed that if the head of the household were employed, this would reflect a less passive, dependent existence for elderly residents in the households and, as a corollary, a more active lifestyle. However, this variable was not significantly related to nutrient intake among this elderly sample.

Sensitization to Diet-Health Relationship

It was hypothesized that a good predictor of nutrient intake might be a person's knowledge about the relationship between diet and health. The 1989-91 CSFII was followed, about 6 weeks later, by a Diet and Health Knowledge Survey (DHKS) that gathered information on attitudes and knowledge about nutrition, diet, and health of the household's main meal planner/preparer. Information from the DHKS could be linked to information on food consumption, and thus, nutrient intake. Earlier model specifications for this study incorporated a knowledge variable that revolved around respondents' answers to questions that tried to gauge their general knowledge about the relationship between diet and health, for example, if they felt what they eat would make a difference in getting a disease, and if they were aware of health problems related to how much of a specific food component was eaten (such as saturated fat, cholesterol, iron, fiber, and calcium). This knowledge variable alone had, for the most part, a minimal effect on respondents' nutrient intake (with the notable exception of vitamin C and magnesium). The knowledge variable's largest effect on the model, however, was to appear to negate previously significant socioeconomic variables. This was due, probably in part, to a reduction in the size of the sample, since about one-fifth of the elderly that had provided nutrient intake data did not provide the attitude/knowledge information for the DHKS.

It has also been suggested by other researchers that sociodemographic variables, like those employed in this study, may serve to mediate the relationship between consumers' awareness of diet-health linkages and actual nutrient consumption (for example, Variyam and others, 1995). Thus, in this study, a different tack was taken. In the CSFII survey, respondents were asked if a doctor had told them that they had a specific disease. Respondents who indicated that a doctor had told them that they had diabetes, heart disease, or cancer were considered in this study to have been sensitized to the possible relationship between diet and health.

Those who reported such sensitization also reported significantly less intake of energy (calories) and fat. It must be recognized, however, that although physicians' prior diagnoses may have sensitized respondents to diet-health relationships, their reduced intakes of calories and fat may also reflect, to some extent, decreased emotional or physical vigor, resulting from an ailment.

Conclusions

Several characteristics of the elderly and their households influenced their nutrient intake. Formal education positively affects the consumption of most nutrients whereas low income, as reflected as a percentage of a household's appropriate poverty threshold, was related to significantly lower intake of most of the nutrient indicators. City dwellers consumed less of all nutrients, although this factor was statistically significant only for iron.

Elderly blacks consumed less calories, fat, vitamins E and B-6, niacin, phosphorus, magnesium, iron, and zinc than did elderly whites. Consumption of protein and niacin declined with advancing age, and women had significantly lower intakes of all nutrients (except vitamin C) than did elderly men. Regional patterns of nutrient intake among the elderly were not particularly distinctive, although elderly residents in the South consumed less calories, protein, fat, vitamins C and B-6, phosphorus, and magnesium than did the elderly in the Northeast. Also, elderly residents of the South consumed more calcium than the elderly in the Midwest. Neither participation in the Food Stamp Program nor receipt of surplus foods was a statistically significant factor, after controlling for income, employment, and other factors. In the case of food stamp participation, a direct comparison of nutrient intake of eligible nonparticipants with that of participants would better assess the effect of this variable. Opportunity for socialization at meals, a factor found to be positively related to nutrient intake by some earlier investigations, was not significant in this study when measured by the presence of two or more members in the household. Those elderly who had been told by a physician that they had a specific disease (diabetes, heart disease, or cancer) had significantly lower intake of energy and fat. This may have been because these respondents were more sensitive or aware of the relationship between diet and their health, although disease-associated emotional or physical disability may have also been a contributing factor.

Based on these exploratory findings, food and nutrition programs for the elderly probably would be more effective if directed toward central city residents, the less educated, and blacks. Because of the relationship between socio-economic status (as evidenced by the poverty index and education) and nutrient intakes, budgeting and planning low-cost nutritious meals may need emphasis.

The statistical model used to explain variations in individual nutrient intakes was not as successful as was expected, although previous research on factors determining individual food or nutrient intakes of other population segments have also displayed models with relative low explanatory powers. Some reasons that tended to have been responsible for the model's inability to explain a larger proportion of variation have already been discussed, that is, possible inadequacies in the socialization and food stamp participation variables. Statistical model aside, it should also be noted that the dietary assessment method used to collect the intake data may have potential disadvantages, for example, underestimating dietary intake or obtaining data not characterizing one's usual diet. Under-reporting and day-to-day variability are problems associated with dietary surveys such as the CSFII. However, the dietary record procedure used in this survey is often regarded as the gold standard against which other dietary survey assessment methods are compared, providing quantitative information on food consumed during the recording period (Thompson and Byers, 1994).

Furthermore, mention should be made of the measurements used for establishing dietary adequacy. Dietary adequacy is achieved when the exogenous supply of nutrients meets an individual's metabolic requirements for nutrients (Posner, 1979). Certainly, the assessment of elderly individuals' nutritional status is enhanced by clinical and biochemical evaluation. Undoubtedly, such factors as chronic and acute disorders, and body size (that is, relationship between height and weight) can affect the nutrient intake and needs of an elderly individual. However, neither functional capacity indices nor anthropometric measures were employed in this investigation. Additional and, perhaps, better predictors of nutrient intake might also include perceived (as opposed to actual) functional health and perceived food preparation problems.

Nutritional well-being is an integral component of the overall health, independence, and quality of life of the elderly. Designing effective methods of achieving optimal nutrition in the older population is a unique challenge for nutrition policymakers. However, basic to improving the health and well-being of the elderly is the provision of better measurements of the variation in nutrient intake and their relationships to socio-economic and other factors.

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