Original Paper

Relation of Age and Self-Reported Chronic Medical Condition Status with Dietary Nutrient Intake in the US Population

Ashima K. Kant, PhD, RD and Arthur Schatzkin, MD, DPH

Queens College of the City University of New York (A.K.K.), Flushing, New York; and National Cancer Institute (A.S.), National Institutes of Health, Bethesda, Maryland

Key words: chronic diseases, age, aging, elderly, nutrient intake, CSFII, NFCS, nutrition survey, morbidity, nutritional status, diet quality

Objective: To examine the association of nutrient intake with age and self-reported chronic medical condition status in a large, nationally representative sample.

Methods: We used data from the Continuing Survey of Food Intakes by Individuals, 1989–1991. The analytic sample included subjects aged ≥25 years with 3 days of dietary data, and medical condition information (n=7,207). A positive response to having been informed by a doctor of having diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke indicated the presence of chronic medical condition(s) (n=2,368). Sex-specific linear and logistic regression analyses adjusted for multiple covariates were used to examine the relation of age and morbidity status with nutrient intake.

Results: In men, age was associated with an increased risk of consuming <100% of the Recommended Dietary Allowance (RDA) of vitamin E, vitamin B_{12}, calcium, zinc, and iron ($p<0.05$), and self-reported morbidity was associated with an increased risk of consuming <100% of the RDA of protein. Relative to men, women were more likely to report less than the RDA of most nutrients examined; however, neither age nor chronic disease status were associated with increased likelihood of reporting <100% of the RDA of any of the nutrients examined. In women, the probability of reporting <100% of the RDA of vitamin A, vitamin B_6, folate, vitamin C, and iron, and in men, the probability of reporting <100% of the RDA of vitamin C, declined with age ($p<0.05$). No adverse effect of age and chronic disease interaction on intake of most nutrients was noted in men or women.

Conclusions: Chronologic age and morbidity were associated with an increased risk of inadequate intake of several nutrients in free-living, independent men but not in women.

INTRODUCTION

The burden of chronic illnesses increases with age. A recent analysis of the 1987 National Medical Expenditure Survey revealed that 88% of 65+ year olds had at least one chronic medical condition [1]. Of the elderly with chronic medical conditions, 69% had more than one [1]. Chronic medical conditions or their pharmacological management may affect nutritional status due to changes in intake, absorption, metabolism, or excretion of nutrients [2]. Also, chronic medical conditions are often associated with increased risk of disability in the elderly [3], which may affect the ability to procure, prepare, and consume food. The presence of morbidity, therefore, is believed to be an important correlate of nutritional health in the elderly.

The elderly are also at an increased risk of marginal intakes of several nutrients due to a variety of reasons unrelated to the presence of morbidity [4]. Given the high prevalence of morbidity with age and the potential impact of morbidities on nutrient intake, surprisingly little is known about whether morbidity modifies the relation of age with nutrient intake. The issue is important because nutritional adequacy can serve not

Paper presented in part at the 1998 Annual Experimental Biology meeting, April 18–22, San Francisco, CA.

Reprints not available from author. Address correspondence requests to: Ashima K. Kant, PhD, Dept. of Family, Nutrition, and Exercise Sciences, Remsen Hall, Room 306E, Queens College of the City University of New York, 65-30 Kissena Blvd., Flushing, NY 11367.

Journal of the American College of Nutrition, Vol. 18, No. 1, 69–76 (1999)
Published by the American College of Nutrition

only as an adjunct to medical management, it may also favorably affect the progression of the disease, improve quality of life, and prolong ability to maintain independent function while contributing to decreased health care expenditure [5,6]. The purpose of this study was to examine the relation of morbidity and age with dietary nutrient intake profiles in a large, nationally representative sample.

METHODS

We used data from the Continuing Survey of Food Intake by Individuals (CSFII), Series II, 1989–1991. The CSFII (1989–91) contains a multi-stage, national probability sample of US households and includes a basic sample containing all-income households and a low-income sample [7]. Dietary information for 3 consecutive days was obtained from all members of sampled households, and included one interviewer administered 24-hour dietary recall and 2-day food records. Sixty-seven percent of selected households participated in the survey and 67% of eligible household members completed 3 days of dietary data for a survey response rate of 45%.

Analytic Sample

For the purpose of analyses reported here, all respondents aged ≥25 years, with 3 complete days of dietary information were eligible for inclusion in the analytic sample (n=7394). From this eligible sample, we excluded women who were pregnant (n=68), or lactating (n=48). Also excluded were subjects who did not respond or answered “don’t know” to any of the questions about morbidity (n=71). The final analytic sample included 7,207 respondents aged ≥25 years (3,023 men and 4,184 women), with an analytic response rate of 43.7%.

Information on Chronic Medical Conditions

The CSFII 1989–91 queried respondents about whether a doctor had ever informed them of having a number of medical conditions. A positive response to questions on having been informed by a doctor about having diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke was considered to indicate morbidity. Using these criteria, 2,368 respondents from the analytic sample had at least one morbid condition (unweighted estimate).

Dietary Variables

The dietary variables examined included 3-day average intakes of energy, percent energy from macronutrients, and percent Recommended Dietary Allowances (RDAs) of the vitamins A, E, B_6, C, B_{12}, folate, and the minerals calcium, zinc, iron, and potassium [8]. These nutrients were selected because they have been identified as current or potential problems in the US population [9], and from available literature on problem nutrients in the elderly [10]. Because RDA is not available for potassium, we used the estimated minimum requirement of healthy adults, 2000 mg, as the standard [8].

In addition, two nutrient-based measures of overall diet quality were developed. These included: 1) Nutrient Adequacy Score 67 (NAS67), and 2) Nutrient Adequacy Score 100 (NAS100). The NAS67 is a modification of a score reported by Davis et al [11], and is a sum of the number of nutrients (from a total of 11-protein, vitamins A, E, B_6, B_{12}, C, folate, and the minerals calcium, zinc, iron, and potassium) reportedly consumed at least at the level of 67% of the age-sex-specific RDA. The NAS100 is similar except using the criterion of 100% of the RDA.

Statistical Analyses

Descriptive statistics for 3-day average dietary intake of energy, percent energy from macronutrients, and selected vitamins and minerals were obtained by categories of chronic medical condition status (none, any), by sex, and by age group (25 to 50, 51 to 64, 65 to 74, and ≥75 years). The percentage of the population in various categories of socio-demographic and lifestyle variables by morbidity status was also obtained. Nutrient estimates are limited to those reportedly consumed in the diet; nutrients consumed as supplements are not included in these estimates.

Linear regression modeling was used to examine the independent effect of age, morbidity, and age-morbidity interaction on each continuously measured dietary variable. All regression models were stratified by sex. The regression models included each dietary variable as an outcome variable, with age (continuous), chronic medical condition status (none, any), race (white, black, hispanic, other), income as percent of poverty threshold (0 to 130%, 131 to 350%, and ≥351%), and an age-morbidity status interaction term as predictor variables.

We also determined the percentage of the population consuming <67% and <100% of the sex-age-specific RDA of various nutrients stratified by sex, and morbidity status. It has been suggested that the use of a fixed cutoff of the RDA, e.g., two-third (67%) of the RDA, for determining adequacy may be inappropriate for a variety of reasons [12]. Therefore, the results are presented using 100% of the RDA as cutoff. Because the outcome in these analyses is dichotomous (consuming <100% or ≥100% of the RDA of each nutrient), we used logistics regression models for examining the relation of age and chronic medical condition status with the risk of consuming <100% or ≥100% of the RDA of various nutrients. The sex-specific logistic regression models included age, morbidity status, race, income, and an age-morbidity status interaction term as covariates.

Due to the complex multi-stage sampling design of the CSFII survey, standard errors of proportions, means, and regression coefficients were determined using special statistical software, SUDAAN [13]. A two step weighting of the CSFII sample combined sampling weights from the basic and the low-income samples into a single sample [7]. The USDA assigned weighting factors also correct for differential probabilities of selection, non-response, and demographic characteristics [7]. Although we used the USDA assigned sampling weights in all analyses, the possibility of differences in the diets of responders and non-responders to the survey may limit the representativeness of our results.

RESULTS

Nearly 28% of the final analytic sample had one or more of the six chronic medical conditions (weighted estimates). While only 14% of those in the 25 to 50 year age group had positive morbidity status, in the age groups 65 to 74 and 75+ years, more than 59% reported one or more medical conditions. The mean age of those without any morbidity was 43.6±0.4 years, and for those with morbidity was 58.8±0.7 years.

The mean±SE of age, and the dietary variables, by morbidity status, and by age group, are presented in Tables 1 and 2 for men and women, respectively.

Age Effect

In both men and women with increased chronologic age, intake of total energy, percent energy from fat, % RDA of protein, and g of alcohol declined, and % energy from carbohydrate increased ($p<0.05$). In men, intake of % RDAs of calcium, and potassium, NAS67, and NAS100 declined with age, but the % RDA of vitamin C increased with age ($p<0.05$). For % RDA of all other nutrients (vitamin A, vitamin E, folate, vitamin B_6, vitamin B_{12}, zinc, and iron), an age effect was not noted ($p>0.05$) in men.

In women, age was related with an increase in the mean

Table 1. Mean±SE of Intake of Energy and Selected Nutrients by Self-Reported Morbidity Status, by Age Group, in Men, CSFII, 1989–91

	No morbidity				Morbidity present			
	25 to 50	51 to 64	65 to 74	≥75	25 to 50	51 to 64	65 to 74	≥75
n	1545	361	177	102	233	231	235	139
Age (years)	36±1	57±1	69±1	79±1	39±1	58±1	69±1	80±1
Energy[1,2,3] (Kcal)	2200±42	2007±46	1937±74	1755±90	2319±83	1888±68	1794±39	1736±49
% energy from:								
CHO	46±1	45±1	49±1	50±1	45±1	46±1	50±1	51±1
Protein	17±1	18±1	17±1	16±1	17±1	18±1	17±1	16±1
Fat[1,2,3]	36±1	36±1	33±1	35±1	37±1	34±1	33±1	33±1
Alcohol[1] (g)	7.5±0.6	6.7±1.1	5.8±1.2	1.8±0.7	7.8±1.4	7.4±1.4	3.7±1.2	3.7±2.6
% age-sex-specific 1989 RDA[a]:								
Protein[1,3]	144±2	136±3	129±4	110±6	155±6	129±4	120±3	113±4
Vitamin A	121±5	161±12	196±25	170±20	159±22	156±17	187±20	154±15
Vitamin E	90±3	97±7	94±7	83±7	109±14	89±7	96±11	83±6
Folate	135±3	140±6	156±10	130±11	152±12	136±7	163±8	147±8
Vitamin B_6	94±2	95±3	103±5	87±7	105±6	94±4	102±4	95±5
Vitamin B_{12}	293±10	279±13	447±137	310±80	331±29	279±19	440±99	246±20
Vitamin C	158±4	163±9	193±27	154±16	157±10	169±12	193±11	184±12
Calcium[1]	105±3	97±4	89±5	89±9	110±5	87±4	95±4	88±4
Zinc	87±2	88±4	83±4	64±5	101±6	84±7	98±13	74±4
Iron	159±4	153±5	184±13	132±9	178±12	147±6	171±9	151±8
Potassium[b,1]	142±2	145±3	149±8	132±8	157±6	143±4	145±4	136±4
Measures of overall nutrient intake:								
NAS67[c,1]	8.91±0.1	9.05±0.2	8.82±0.2	8.02±0.4	9.33±0.2	8.72±0.2	8.79±0.2	8.97±0.2
NAS100[d,1]	6.28±0.1	6.51±0.2	6.41±0.3	5.44±0.4	7.01±0.2	6.19±0.2	6.50±0.3	6.26±0.2

* Having been informed by a doctor about the presence of diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke indicated morbidity status.

[a] The 1989 RDAs provide only two age categories, 25 to 50, and 51+. The RDAs for all nutrients in this table are similar for the two age categories [8].

[b] There is no RDA for potassium, 2000 mg was used as the standard [8].

[c] NAS67: Nutrient adequacy score 67: Sum of nutrients consumed at the level of at least 67% of RDA from a total of 11 (protein, vitamins A, E, B_6, B_{12}, C, folate, calcium, zinc, iron, and potassium).

[d] NAS100: Nutrient adequacy score 100: Sum of nutrients consumed at the level of at least 100% of RDA from a total of 11 (protein, vitamins A, E, B_6, B_{12}, C, folate, calcium, zinc, iron, and potassium).

[1] Beta coefficient associated with age was negative and significant ($p<0.05$) in regression models with dietary variable as dependent variable and age, morbidity status, income, race, and age*morbidity interaction as predictor variables.

[2] Beta coefficient for morbidity was negative and significant ($p<0.05$) in regression models mentioned above.

[3] Beta coefficient for the age morbidity interaction was significant ($p<0.05$) in regression models mentioned above.

Table 2. Mean±SE of Intake of Energy and Selected Nutrients by Self-Reported Morbidity Status, by Age Group, in Women, CSFII, 1989–91

	No morbidity				Morbidity present			
	25 to 50	51 to 64	65 to 74	≥75	25 to 50	51 to 64	65 to 74	≥75
n	1842	435	222	257	410	370	401	349
Age (years)	36±1	57±1	69±1	81±1	40±1	58±1	69±1	81±1
Energy[1]	1525±19	1437±33	1402±46	1358±51	1543±36	1481±53	1394±29	1360±43
% energy from:								
CHO[2]	48±1	49±1	51±1	50±1	48±1	50±1	50±1	52±1
Protein	17±1	18±1	18±1	17±1	17±1	17±1	17±1	17±1
Fat[1]	35±1	34±1	33±1	34±1	36±1	34±1	34±1	33±1
Alcohol[1] (g)	2.9±0.3	3.3±0.9	1.1±0.4	1.2±0.7	2.7±0.5	2.5±0.7	1.4±0.4	0.9±0.4
% Sex-age-specific 1989 RDA[a]:								
Protein[1]	125±1	125±3	121±3	110±4	126±3	125±4	118±2	111±3
Vitamin A[2]	139±9	185±13	171±14	220±19	118±7	171±11	189±11	176±10
Vitamin E	84±2	86±7	81±6	79±5	81±4	82±4	89±5	83±6
Folate[2]	113±2	129±6	127±5	125±8	115±5	127±6	128±4	125±5
Vitamin B_6	84±1	96±3	97±4	92±5	84±3	93±4	90±3	88±3
Vitamin B_{12}	202±12	211±11	200±16	225±35	184±10	201±11	213±15	186±19
Vitamin C[2,3]	134±3	161±8	172±8	152±12	114±5	159±8	157±7	159±9
Calcium	76±1	78±3	76±4	71±3	76±3	74±3	74±2	75±3
Zinc	74±1	76±3	71±3	72±4	74±2	76±3	72±2	68±3
Iron[2]	75±2	121±5	121±7	118±8	77±3	118±5	113±3	117±6
Potassium[b]	106±1	118±3	117±4	111±4	107±3	118±4	114±3	107±3
Measures of overall nutrient intake:								
NAS67[c,2]	7.59±0.1	8.41±0.2	8.41±0.2	8.18±0.3	7.45±0.2	8.49±0.2	8.52±0.2	8.03±0.2
NAS100[d,2]	4.57±0.1	5.55±0.2	5.40±0.3	5.27±0.3	4.62±0.2	5.49±0.2	5.49±0.2	5.12±0.3

* Having been informed by a doctor about the presence of diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke indicated morbidity status.

[a] The 1989 RDAs provide only two age categories, 25 to 50, and 51+. The RDAs for all nutrients except iron (which is lower in the 51+ year category) in this table are similar for the two age categories [8].

[b] There is no RDA for potassium, 2000 mg was used as the standard [8].

[c] NAS67: Nutrient adequacy score 67: Sum of nutrients consumed at the level of at least 67% of RDA from a total of 11 (protein, vitamins A, E, B_6, B_{12}, C, folate, calcium, zinc, iron, and potassium)

[d] NAS100: Nutrient adequacy score 100: Sum of nutrients consumed at the level of at least 100% of RDA from a total of 11 (protein, vitamins A, E, B_6, B_{12}, C, folate, calcium, zinc, and iron, and potassium)

[1] Beta coefficient associated with age was negative and significant ($p<0.05$) in regression models with dietary variable as dependent variable and age, morbidity status, income, race, and age*morbidity interaction as predictor variables.

[2] Beta coefficient associated with age was positive and significant ($p<0.05$) in regression models mentioned above.

[3] Beta coefficient for morbidity was positive and significant ($p<0.05$) in regression models mentioned above.

intakes of % RDAs of vitamin A, folate, vitamin C, iron, NAS67, and NAS100 ($p<0.05$). For all other nutrients (vitamin E, vitamin B_6, vitamin B_{12}, calcium, zinc, and potassium), age effect was not significant ($p>0.05$) in women.

Morbidity Effect

Men without morbidity had higher mean intakes of energy, % energy from fat, and percent RDA of protein, but lower % energy from carbohydrate, relative to men with morbidity ($p<0.05$). Morbidity was associated with higher % RDA of vitamin C in women ($p<0.05$).

Age and Morbidity Interaction

No interaction effect of age and chronic medical condition status on nutrient intake was evident in women. In men, the age-morbidity interaction effect was noted for intake of energy, % energy from carbohydrate and fat, and % RDA of protein. Age was associated with lower energy, % energy from fat, % RDA of protein, and higher % energy from carbohydrate in men with and without morbidity; however, the slope was steeper in those with morbidity for each of these nutrients.

Percentage of the Population at Nutritional Risk

Table 3 presents the percentage±SE of the population reporting <100% of the sex-age-specific 1989 RDA of the various nutrients, by morbidity status, by sex, by age group. Irrespective of morbidity status, a large percentage of the population in every agegroup reported consuming less than 100% of the RDA of vitamin A, vitamin E, vitamin B_6, and the minerals zinc, and calcium. Likelihood of consuming <100% of all nutrients except vitamin A was higher in women relative to men ($p<0.05$). Expectedly, a higher proportion was at risk using 100% of the RDA as cutoff compared with the lower

Table 3. Percentage±SE of the Population Consuming Less than 100% of the Sex-Age-Specific Recommended Dietary Allowance (RDA) of Various Nutrients[a], by Self-reported Morbidity Status, by Sex, by Age Group, CSFII, 1989–91

	No morbidity				Morbidity present			
	25 to 50	51 to 64	65 to 74	≥75	25 to 50	51 to 64	65 to 74	≥75
Men								
Protein[1,3]	20±1	17±2	25±4	39±7	7±2	26±4	33±4	41±5
Vitamin A	59±2	43±4	42±5	45±7	54±6	50±5	41±5	44±7
Vitamin E[1,4]	71±2	70±3	72±5	77±6	62±4	72±5	77±4	76±6
Folate	39±2	34±3	29±4	40±8	37±4	34±4	26±4	24±5
Vitamin B_6	65±2	64±3	56±5	80±5	63±5	62±5	55±5	61±6
Vitamin B_{12}[1]	7±1	10±3	11±3	17±6	4±1	11±2	12±3	12±4
Vitamin C[2,4]	39±2	37±4	35±5	36±7	38±5	34±4	27±4	18±3
Calcium[1]	54±2	64±4	70±5	64±7	47±5	68±5	66±4	68±5
Zinc[1]	73±2	77±3	76±4	92±3	63±5	83±3	72±4	85±5
Iron[1]	22±2	18±2	18±3	37±7	13±3	22±4	22±3	25±5
Potassium[b]	22±2	17±2	24±5	29±7	11±3	19±4	19±3	17±5
Women								
Protein	29±1	28±3	33±4	39±6	29±4	30±3	26±3	43±4
Vitamin A[2]	56±2	40±3	44±5	35±5	55±3	37±3	42±4	35±3
Vitamin E	75±2	74±4	78±4	77±6	75±3	78±3	75±3	78±4
Folate[2]	51±2	42±3	39±4	49±6	50±4	35±4	37±4	40±4
Vitamin B_6[2]	74±2	61±3	59±4	71±5	74±4	69±4	66±3	65±4
Vitamin B_{12}	23±2	19±3	22±3	17±4	21±3	20±3	21±3	30±3
Vitamin C[2]	46±2	38±3	31±3	30±5	49±4	34±4	35±4	35±4
Calcium	77±2	75±3	81±4	87±3	77±3	83±3	83±2	79±4
Zinc	84±1	80±3	88±4	83±5	82±3	81±3	86±2	87±3
Iron[2,4]	83±2	48±4	47±5	48±7	80±3	48±5	49±3	52±4
Potassium[b]	47±2	38±4	38±5	36±6	45±4	35±4	31±3	45±5

* Having been informed by a doctor about the presence of diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke indicated morbidity status.

[a] The 1989 RDAs provide only two age categories, 25 to 50, and 51+. With the exception of a lower RDA for iron for women aged 51+ years, the RDAs for all other nutrients in this table are similar for the two age categories.

[b] There is no RDA for potassium, 2000 mg was used as the standard [8].

[1] The risk of reporting <100% of the RDA increased with age ($p<0.05$) in logistic regression models with <100% and ≥100% of the RDA of a nutrient as outcome, and age, morbidity, race, income, and age*morbidity interaction as predictor variables.

[2] The risk of reporting <100% of the RDA decreased with age ($p<0.05$) in regression models mentioned above.

[3] The risk of reporting <100% of the RDA was higher in those with morbidity ($p<0.05$) in regression models mentioned above.

[4] The risk of reporting <100% of the RDA was lower in those with morbidity ($p<0.05$) in regression models mentioned above.

cutoff of 67%. (Data using 67% of the RDA as standard are not shown.)

In men, age was associated with an increase in the likelihood of reporting <100% of the RDA of protein, vitamin E, vitamin B_{12}, calcium, zinc, and iron, but a decrease in the likelihood of reporting less than the RDA of vitamin C ($p<0.05$). In women, age did not increase the risk of consuming <100% of the RDA of any of the nutrients examined. Conversely, with advancing age, women were less likely to report <100% of the RDA of vitamin A, vitamin B_6, folate, vitamin C, and iron ($p<0.05$).

A slightly higher proportion of men reporting chronic medical condition(s) were at risk of consuming less than the RDA of protein, but the probability of reporting less than the RDA of vitamin E was higher in men without morbidity ($p<0.05$). Women with morbidity were less likely to report <100% of the RDA of iron. Interaction effect of age and chronic medical condition status on vitamin C intake was evident in men. The age-associated decline in men reporting <100% of the RDA of vitamin C was greater in those with morbidity.

Socio-Demographic and Lifestyle Characteristics of the Analytic Sample

Table 4 presents the percentage of subjects in various categories of socio-demographic and lifestyle variables, by morbidity status. Women made up nearly 57% of those with morbidity. Approximately 70% of those with morbidity were over the age of 51 relative to only 27% for those without morbidity. Those with morbidity were more likely to have <12 years of schooling, and lower income.

Morbidity was associated with light level of leisure-time physical activity. Sixty-three percent of those without morbidity described their health status as excellent and very good compared with only 29% of those with morbidity. Not surprisingly, a higher proportion of those with morbidity reported the

Table 4. Socio-Demographic and Lifestyle Characteristics of Subjects by Self-Reported Morbidity, CSFII, 1989–91[1]

	No morbidity	Morbidity present
n	4839	2368
Gender		
Men	49	43
Women	51	57
Age group		
25 to 50 years	73	31
51 to 64 years	17	27
65 to 74 years	6	24
≥75 years	4	18
Ethnicity		
White	80	80
Black	10	13
Hispanic	8	5
Other	2	2
Level of education		
<12 years	16	29
12 years	33	34
>12 years	50	36
Income (as percentage of poverty threshold)		
0 to 130 %	12	20
131 to 350 %	37	40
≥350 %	51	40
Smoking status		
Never smoker	52	46
Former smoker	21	31
Current smoker	27	22
Disability		
Yes	8	33
No	92	67
Level of leisure time physical activity		
Heavy	14	8
Moderate	48	35
Light	37	54
Bedridden	<1	3
Self-described health status?		
Excellent	27	8
Very good	36	21
Good	29	39
Fair	7	23
Poor	<1	8
Self-opinion of healthfulness of own diet?		
Excellent	16	11
Very good	30	28
Good	37	43
Fair	13	15
Poor	4	4

* Having been informed by a doctor about the presence of diabetes, heart disease, high blood pressure, cancer, osteoporosis, and stroke indicated morbidity status.
[1] All percentages were obtained using sample weights.

presence of disability. Fewer respondents with morbidity rated their diet as healthful.

DISCUSSION

Both aging and morbidity have been suggested as predictors of nutritional risk [4]. In our study, this suggestion did not apply equally to men and women. In men, the dietary intakes of several nutrients (protein, calcium, and potassium) declined with age and chronic medical condition status (protein). Although, relative to men, women had lower dietary intake of percent RDA of nearly every nutrient examined in this study, aging and morbidity did not appear to adversely affect intake of most nutrients in women. Instead, despite an age-associated decline in energy intake, the intake of percent RDA of several nutrients increased with age in women. Also, overall diet quality, as measured by NAS67 and NAS100, number of nutrients reported at the level of at least 67% or 100% of the RDA, improved with age in women (which may be partially attributable to a lower RDA for iron in older women, as discussed below), but declined in men.

Because examining mean nutrient intakes provides little information about the percentage of population at nutritional risk, according to Goodwin's suggestion [14], we examined the percentage of men and women consuming less than 100% of the RDA of nutrients according to age and morbidity status (Table 3). In men, increased risk of consuming less than the RDA of several nutrients (protein, vitamin E, vitamin B_{12}, calcium, zinc, and iron) was associated with age, and morbidity (protein). Although relative to men, a higher proportion of women consumed less than the RDA of nearly all nutrients examined, age or morbidity were not associated with an increased risk of consuming less than the RDAs. Conversely, the likelihood of consuming less than the RDA of vitamin A, vitamin C, folate, vitamin B_6, and iron declined with age in women. Others have also reported gender differences in nutrient intakes of free living elderly [15,16]. Generally, the age related trends in macro- and micronutrient intake in our study are comparable to estimates from the first phase of the third National Health and Nutrition Examination Survey [17,18]. However, because of the cross-sectional nature of our study, cohort and aging effects can not be differentiated. Notably though, cohort effects were not seen for energy and macronutrient intake in the Baltimore Longitudinal Study of Aging [19].

Limitations of the current RDAs as standards for evaluating age-specific nutrient intake also affect the interpretation of data reported in this study. The 1989 RDAs categorize adults into two categories, 25 to 50 and 51+ years [8]. Due to paucity of data on older adults, past RDAs reflected extrapolation of data from younger adults [20]. With the exception of a lower iron RDA for women in the 51+ category, the RDAs of other nutrients examined in the present study are the same for the two age categories [8]. After reviewing the available evidence, Russel concluded that the 1989 RDAs for vitamin B_6, folate, vitamin B_{12}, vitamin D, and calcium may be inadequate for the elderly, where as the RDA for vitamin A may be too high [20]. Future RDAs will likely be different due to the increased availability of evidence on nutrient requirements of older adults, and the evolution in current thinking about the role of nutrients in chronic disease prevention [21].

Our data support the notion of age differences in attention to dietary guidance reported earlier in the nutrition monitoring report [9]. In both men and women, percent energy from fat declined and percent energy from carbohydrate increased with age. These trends may reflect age-associated patterns of food selection. For example, the 60+ year olds were more likely to consume five or more servings of fruits and vegetables, lower fat dairy products, fish and poultry, but were less likely to report beef or salad dressings [9]. In women, these presumed age-associated differences in food selection affected intake of several nutrients favorably. However, in men, the risk of inadequate intake of nutrients contributed by animal foods, and visible or hidden fats (protein, vitamin E, vitamin B_{12}, calcium, zinc, and iron) increased with age. Further investigation of gender and age differences in food selection practices with their potential impact on nutrient intakes of the US population is indicated.

Most available studies of the relation of nutrient intake with morbidity and age have studied elderly subjects (e.g., over 65 years), therefore, the results from these studies are not directly comparable to those reported here. Elderly Finnish men (but not women) with chronic diseases had lower energy intake relative to those without disease [22]. Similar associations were noted in the present study. Free-living elderly with poor physical health status were reported to have lower intakes of vitamins A and C [23,24]. We noted no such associations.

Examination of nutrient intake is only one parameter for assessment of nutritional health. Nutrient absorption, metabolism, utilization, and excretion may be altered by age, pathologic states, or their pharmacologic management [25,26]. Therefore, a comprehensive assessment should include biochemical, and functional measures of nutritional status, which are not available in this study.

It should be noted that the estimates of energy intake for adult participants of CSFII have been reported to be approximately 350 kcals lower than comparable estimates from the first phase of the NHANES III, 1988–91 [9], suggesting underreporting of food intake in the CSFII sample. Underreporting of food intake has been recognized as a problem in all dietary surveys including the NHANES [27]. Because nutrient intake is strongly correlated with energy intake [28], it is likely that the nutrient intake may be underestimated in our study and the proportion at risk of consuming less than the RDA of various nutrients may be overestimated. However, despite underreporting in both men and women, mean intakes for most nutrients were close to or above the RDAs. Whether a differential in qualitative misreporting due to age or morbidity status exists is not known. To our knowledge the issue of qualitative misreporting has been examined in relation to adiposity only [29,30].

The results of the present study should be interpreted cautiously with the following limitations in mind. First, chronic medical condition status was based on self-report of six medical conditions. No medical record or other health history information was available for this sample to validate the chronic medical condition status measure. However, self-report data for major chronic conditions have been shown to be valid in both young and older subjects [31–33]. Also, the association of increased frequency of disability, light level of physical activity, and poor self-described health status in those with self-reported chronic medical condition(s) provides an indirect validation of this measure.

Secondly, the CSFII questionnaire did not include queries on all leading causes of morbidity in the elderly. Especially notable omissions include arthritis, respiratory diseases and cognitive impairments, which may potentially have impact on dietary intake [23,34]. Therefore, it is possible that respondents with medical conditions not included in the CSFII questionnaire or those with undiagnosed disease may be misclassified into the morbidity-free group. Such misclassification may contribute to inability to find a chronic disease effect in regression models. Furthermore, no information was collected on severity of the self-reported medical condition(s), living arrangements, care-giver support, and functional status that might affect nutrient intake. Also, the low response rate to the CSFII survey indicates cautious generalization of the data presented in this study.

In conclusion, neither age nor morbidity were correlates of increased nutritional risk for women in this study. However, in men, an increased risk of consuming <100% of the RDA of dietary protein, vitamin E, vitamin B_{12}, calcium, zinc, and iron was associated with increasing chronologic age, and morbidity (protein only). Thus implying that nutritional interventions for older men require particular attention to these nutrients. Gender differences in food selection patterns should be examined to elucidate gender differences in the relation of age with nutrient intake. More information on age-differences in qualitative and quantitative misreporting is also needed. Lastly, examination of age and morbidity interaction in relation to nutritional health using objective measures of nutritional status presents as an additional area of study.

ACKNOWLEDGMENTS

We thank Barry Graubard, PhD, National Cancer Institute, Bethesda, MD, for statistical advice, and Lisa Licitra Kahle, IMS, Silver Spring, MD, for computing assistance.

REFERENCES

1. Hoffman C, Rice D, Sung H: Persons with chronic conditions. Their prevalence and costs. JAMA 276:1473–1479, 1996.
2. Dwyer JT: Screening Older Americans' Nutritional Health; Current Practices and Future Possibilities. Washington, DC: Nutrition Screening Initiative, 1991.
3. Sorenson A, Chapman N, Sundwell DN: Health promotion and disease prevention in the elderly. In Chernoff R (ed): "Geriatric

Nutrition. The Health Professional's Handbook." Gaithersburg, MD: Aspen Publishers, Inc., pp 449–483, 1991.
4. White JV: Risk factors for poor nutritional status in older Americans. Am Fam Phys 44:2087–2097, 1991.
5. Cope K: Malnutrition in the elderly, a national crisis. Washington, DC: US GPO, 1996.
6. Morley JE, Silver AJ, Fiatarone M, Mooradian AD: Geriatric grand rounds: Nutrition and the elderly. J Am Geriat Soc 34:823–832, 1986.
7. US Department of Agriculture, Agricultural Research Service: "Food and Nutrient Intake by Individuals in the United States, 1 Day, 1989–91. Continuing Survey of Food Intakes by Individuals, 1989–91." NFS Report Number 91–2, 1995.
8. Food and Nutrition Board: "Recommended Dietary Allowances," 10th ed. Washington, DC: National Academy Press, 1989.
9. Interagency Board for Nutrition Monitoring and Related Research: "Third Report on Nutrition Monitoring in the United States," Vol. 1. Washington, DC: US Gov. Printing Office, 1995.
10. Morley JE: Nutritional status of the elderly. Am J Med 81:679–695, 1986.
11. Davis MA, Murphy SP, Neuhaus JM, Lein D: Living arrangement and dietary quality of older adults. J Am Diet Assoc 90:1667–1672, 1990.
12. Food and Nutrition Board: "Nutrient Adequacy: Assessment Using Food Consumption Survey Data." Washington, DC: National Academy Press, pp 10–16, 1986.
13. Shah BV, Barnwell BG, Hunt PN, Lavange LM: "SUDAAN User's Manual. Software for Statistical Analysis of Correlated Data," Release 7.0. Research Triangle Institute, 1996.
14. Goodwin JS: Social, psychological and physical factors affecting the nutritional status of elderly subjects: separating cause and effect. Am J Clin Nutr 50:1201–9, 1989.
15. Hunter KI, Linn MW: Cultural and sex differences in dietary patterns of the urban elderly. J Am Geriatr Soc 27:359–363, 1979.
16. Davis MA, Randall E, Forthofer RN, Lee EU, Margen S: Living arrangements and dietary patterns of older adults in the United States. J Gerontol 40:434–442, 1985.
17. McDowell MA, Briefel RR, Alaimo K, Bischof AM, Caughman CR, Carroll MD, Loria CM, Johnson CL: Energy and macronutrient intakes of persons aged 2 months and over in the United States: Third National Health and Nutrition Examination Survey, Phase 1, 1988–91. Advance data from vital and health statistics; No. 255. Hyattsville, MD: National Center for Health Statistics. 1994.
18. Alaimo K, McDowell MA, Briefel RR, Bischof AM, Caughman CR, Loria CM, Johnson CL: Dietary intake of vitamins, minerals, and fiber of persons aged 2 months and over in the United States: Third National Health and Nutrition Examination Survey, Phase 1, 1988–91. Advance data from vital and health statistics; No. 258. Hyattsville, MD: National Center for Health Statistics. 1994.
19. Elahi VK, Elahi D, Andres R, Tobin J, Butler MG, Norris AH: A longitudinal study of nutritional intake in men. J Gerontol 38:162–180, 1983.
20. Russell RM: New views on the RDAs for older adults. J Am Diet Assoc 97:515–518, 1997.
21. Food and Nutrition Board: "How should the Recommended Dietary Allowances Be Revised?" Washington, DC: National Academy Press, 1994.
22. Laakkonen EI, Suntioinen S, Penttil'a IM, Uusitupa MI, Rissaanen PM: The nutritional status of Finnish home-living elderly people and the relationship between energy intake and chronic diseases. Age Ageing 25:133–138, 1996.
23. Walker D, Beauchene RE: The relationship of loneliness, social isolation, and physical health to dietary adequacy of independently living elderly. J Am Diet Assoc 91:300–304, 1991.
24. Bianchetti A, Rozzini R, Carabellese C, Zanetti O, Trabucchi M: Nutritional intake, socioeconomic conditions, and health status in a large elderly population. J Am Geriat Soc 38:521–526, 1990.
25. Watson RR (ed): "Handbook of Nutrition in the Aged." Ann Arbor, MI: CRC Press, 1994.
26. Chernoff R (ed): "Geriatric Nutrition. The Health Professional's Handbook." Gaithersburg, MD: Aspen Publishers Inc., 1991.
27. Bingham SA: The use of urine samples and energy expenditure to validate dietary assessments. Am J Clin Nutr 59:227S–231S, 1994.
28. Willett W: Implications of total energy intake for epidemiologic analyses. In Willett W (ed): "Nutritional Epidemiology." New York, NY: Oxford University Press, pp 245–271, 1990.
29. Heitmann BL, Lissner L: Dietary underreporting by obese individuals—is it specific or non-specific? Br Med J 311:986–989, 1995.
30. Lissner L, Lindroos A-K: Is dietary underreporting macronutrient-specific? Eur J Clin Nutr 48:453–454, 1994.
31. Bush T, Miller SR, Golden AL, Hale WE: Self-report and medical record report agreement of selected medical conditions in the elderly. Am J Pub Health 79:1554–1556, 1989.
32. Sherbourne CD, Meredith LS: Quality of self-report data: A comparison of older and younger chronically ill patients. J Geronotol 47:S204–S211, 1992.
33. Miilunpalo S, Pasanen M, Oja P, Vuori I, Haapanen N: Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. Am J Epidemiol 145:762–769, 1997.
34. Chapman KE, Winter L: COPD: using nutrition to prevent respiratory function decline. Geriatrics 51:37–42, 1996.

Received December 1997; revision accepted July 1998.