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Measurement of Dietary Intake in the UNC Alumni Heart Study[1]

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Background. **Research needs to identify diet and disease associations to provide direction about effecting change in individuals with dietary behaviors that increase risk of chronic disease. Inclusion of dietary assessment in the University of North Carolina Alumni Heart Study (UNCAHS) provides the opportunity to prospectively investigate dietary intake and chronic disease associations with measures of personality and behavioral risk factors.**

Methods. **Development of the UNCAHS food frequency questionnaire and nutrient intake of 4,443 middle-aged men and women is provided stratified by total fat and vitamin A intake within demographic and health behavior categories.**

Results. **Alumni consume diets close to that recommended by current dietary guidelines. Both men and women have low calcium intake. Thirty-nine percent of the alumni consume diets with 30% of kilocalories from fat or less and 88% meet the RDA for vitamin A. Never smokers had lower fat diets and greater intakes of vitamin A than former or current smokers. Over 54% of alumni currently took vitamin/mineral supplements.**

Conclusions. **UNCAHS participants will be tracked as they approach older ages with apparently less risk for diet-related chronic diseases than many Americans. The psychosocial correlates of these eating behaviors will be evaluated as disease endpoints occur.**

Key Words: **diet; nutrient intake; chronic disease; psychosocial.**

INTRODUCTION

Many cohort studies have been conducted among men and women concerning the relationship between diet, lifestyle behaviors, and chronic disease outcomes [*1–15*]. The range of dietary components explored has included, but is not limited to, energy, fats and fatty acids, cholesterol, protein, carbohydrate, fiber, alcohol, antioxidant vitamins, and calcium and other minerals, as well as consumption of specific foods such as fruits and vegetables. Findings from these epidemiological studies have supported and challenged results from laboratory studies as well as generated hypotheses for nutrient and chronic disease associations that need a biologic mechanism defined [*16–19*].

The Healthy People 2000 Goals state that research needs to both identify diet and disease associations and to provide knowledge about how to effect change in individuals that are practicing lifestyle habits that put them at high risk for chronic diseases such as cancer, cardiovascular disease and osteoporosis [*20*]. Food consumption is a complex behavior process that is motivated and controlled by both internal and external cues [*21*]. Interventions to effect change in dietary habits have been developed and shown to be effective among selected populations. Several behavioral theories have been applied to the strategies used to implement dietary interventions that rely heavily on understanding the internal and external barriers and motivations that elicit behavioral activities.

Thus, the inclusion of dietary intake to the University of North Carolina Alumni Heart Study (UNCAHS) provides a unique opportunity to prospectively investigate dietary intake and chronic disease associations with the availability of measures of personality and traditional behavioral risk factors for chronic disease. Description of the psychosocial correlates of the UNCAHS have been described previously [*22–33*]. The UNCAHS is a longitudinal study of men and women who completed the Minnesota Multiphasic Personality Inventory (MMPI) [*34*] while attending the University of North Carolina (UNC) in Chapel Hill during the period of 1964–1966. The UNCAHS cohort was born primarily from 1940 to 1949 and thus is approaching age 50 years, and as the cohort ages will contribute to disease

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outcomes with sufficient prevalence to study. A unique feature of this cohort is the educational level of the participants, with 47% having masters, doctoral or professional degrees. Because the cohort is highly educated, capable of obtaining and comprehending preventive health information, and has the economic resources to freely select food intake, it is of interest to evaluate what these individuals choose to eat and to determine the disease consequences of the eating behavior. Understanding the psychosocial factors motivating dietary behavior among this group could help provide direction to future intervention activities and evaluation instruments, as well as understanding chronic disease etiology.

This article describes development of the UNCAHS food frequency questionnaire (FFQ) and the nutrient intake of the cohort. Participants are stratified by intake levels of two dietary components hypothesized to affect the risk of cardiovascular disease (CVD) and cancer: total fat and vitamin A. Dietary fat intake has been positively associated with serum cholesterol levels that have been linked to CVD because they modulate lipoproteins and can influence blood pressure and platelet aggregation [*16*]. A wealth of research has investigated the relationship between total fat intake and cancer with the possibility that higher intakes are associated with lung, colon, rectum, breast and prostate cancers [*16–18*]. Vitamin A consists of two components, carotenoids and retinol, both of which have been extensively explored in relationship to cancer. Carotenoids are possibly associated with decreased risk of lung, esophagus, stomach, colon, rectum, breast, and cervical cancers while retinol has not been found to alter risk of cancers in humans [*17*]. Total fat intake will be used in this study as a surrogate for negative health behavior and intake of vitamin A will be used as a surrogate for positive health behavior. Distributions of participants are described across levels of intake within selected demographic and health behavior categories.

METHODS

Food Frequency Questionnaire Development

Rationale. A population-specific, self-administered, semi-quantitative FFQ was developed for use in the UNCAHS for a variety of reasons: (a) to ensure adequate representation of the food sources of nutrients in this highly educated, middle to upper-income population; (b) to have the nutrient and food data managed in-house without machine-readable data collection forms; and (c) to include foods important to investigators' hypotheses regarding diet and chronic disease outcomes in this cohort. The major chronic disease outcomes followed by the UNCAHS are CVD, hypertension, cancer, diabetes and osteoporosis. The FFQ has the ability to estimate intake of 39 dietary components, including energy, macronutrients, alcohol, fiber, vitamins, minerals, caffeine, individual carotenoids and selenium [*35–40*].

Food sources of nutrients. The first step in development of the FFQ food list was to determine the UNCAHS participants' food sources of the nutrients of interest. The UNCHAS has a longitudinal pilot sample; drawn from the Alumni Association files in 1986 who have been sent various versions of the UNCAHS questionnaires during pilot-testing activities. In the fall of 1993 a preliminary postcard was sent to these members to determine willingness to participate in the dietary questionnaire development. A 1-day food record of all of the foods and beverages consumed during a specific day during the week was mailed to the 259 volunteer participants. Detailed instructions were provided to instruct participants to record brand names, food preparation techniques, and recipes as well as two-dimensional food models to assist estimation of portion sizes consumed. The days of the week were randomly assigned to participants to provide equal representation of the days of the week. A total of 202 (78%) persons responded and all provided acceptable food records for analyses.

Food records to FFQ. The foods reported consumed on the food records were coded and nutrients analyzed using the Food Intake Analysis System [*35*], which utilizes the USDA Survey Nutrient Data Base Version 2.3 [*41*]. The UNCAHS FFQ was developed using standard approaches for creating the food groups and nutrient values [*42,43*]. The percentage of contribution of individual foods to total intake of each nutrient was calculated to identify the important foods for inclusion on the FFQ. The 202 participants consumed 1145 different foods, which were grouped into 153 mutually exclusive food items for inclusion on the FFQ (Appendix, FFQ Food list). The extensive population-specific food list includes many foods on the well-known Block Health Habits and History Questionnaire [*42*] and Willett Questionnaire [*44*] as well as those additional foods that were the most important food sources of energy; total fat; saturated fat; cholesterol; fiber; folate; vitamins A, C, and E; and calcium among the UNCAHS.

The majority of the foods on the FFQ are those found on other commonly used FFQs; however, specific modifications to this questionnaire allows investigation of the role of individual carotenoids, caffeine and specific foods such as soy products and their relation to chronic disease. This entailed splitting food groups that other FFQs may have combined; i.e. chocolate-flavored items were separated from other flavors and caffeine-containing beverages were singled out to allow tracking caffeine intake, and to investigate individual carotenoids for example, greens and squashes were carefully separated. As well, foods were included that have been

hypothesized to be associated with risk of chronic disease, i.e., tofu or soybeans, garlic and red wine. Foods that were fat-modified were included in the FFQ to enhance classification of fat exposures, for example: no-fat and low-fat yogurt, no-fat tortilla chips, and low-fat cream cheese [*45*].

The UNCAHS FFQ also included an open-ended section at the close for participants to add in any other foods that they had consumed at least once during the last month and indicate the frequency of consumption. With the population-based food list and this open-ended section it would be possible to capture the foods that the population consumed at least once a month. The validity and reproducibility of the food frequency questionnaire have been well established by multiple studies using a wide variety of formats [*46,47*].

FFQ nutrients, portion size, and reference period. Each food on the FFQ represents the weighted average of the nutrient amounts of similar foods. For example, the food item corn represents all of the types of corn, fresh, frozen and canned, grouped into one food on the FFQ called corn, with a weighted nutrient average from these types of corn. However, some foods on the FFQ represent a singular food due to the specificity of the preparation method, the brand name, or the generic nature of the food item, i.e., cantaloupe. The FFQ nutrient values were based on the proportional consumption of individual foods by the UNCAHS sample and data from consumption of foods by the United States population in our two large national dietary surveys, the Continuing Survey of Food Intakes of Individuals (CSFII) and the National Heath and Nutrition Examination Survey (NHANES) [*41*]. The standard portion size of each food on the FFQ is a weighted average of the food portions reported by the UNCAHS participants. Average weighted portion sizes were determined for each of the FFQ food records of the UNCAHS participants and the standard servings from the CSFII data that were available in FIAS [*35*]. These portion sizes were used to calculate nutrient intake with the frequency of consumption data collected from the participants in the survey.

The reference time period for the recall of usual food intake from the FFQ was the past month (4 weeks). A measure of current, usual intake was desired to establish a baseline for investigating associations with future chronic disease outcomes. If foods are not consumed at least once a month during the course of a year their overall contribution to usual nutrient intake is typically minimal.

Pilot test of the FFQ. In spring 1994, a different group of 192 UNCAHS participants were asked their willingness to complete a pilot version of the FFQ by returning a postcard indicating availability. A total of 122 were asked if they were willing to receive the FFQ and 92 (75.4%) agreed. Of these, 70 (76%) completed the pilot version of the mailed, self-administered FFQ and made comments on the receptivity of the design, format and content of the directions and the appropriateness of the food list. The design of the UNCAHS is to gather data from participants in a mailed questionnaire; thus the FFQ needed to provide clear, succinct directions that would ensure the highest level of understanding and clarity of responses from the participants. The pilot FFQs were not analyzed for nutrient amounts. The FFQ forms were evaluated subjectively to determine how the people used the form, their attentiveness to directions, and their suggestions for clarity on the food descriptions. The comments were minor and mainly regarded clarification of food names.

UNCAHS FFQ sample population. In September 1994, UNCAHS Questionnaire 6 (Q6), which included a one-page health update and some general well-being questions, as well as the 153-item food frequency questionnaire was mailed to 6,111 persons. Of the 6,111, 4,662 returned Q6 (76.3%) of whom 4,446 did the FFQ. This is 95.4% of those who completed this mailing and 72.8% of those mailed a questionnaire. Only 3 subjects were excluded for this report, 1 with energy intake greater than 7,000 kcal/day and 2 due to lack of demographic variables obtained from previously mailed questionnaires, leaving 4,443 (2,872 males and 1,571 females) for analyses. The participants are 99% white, 89% are employed full-time, and they reside predominately in the southeastern United States [*23*].

At the close of the FFQ food list was an open-ended question to allow participants to describe any other food they had eaten at least once during the last month and how often it was consumed. Only 584 persons evenly distributed by men and women reported an additional food consumed with adequate descriptive information and frequency of use. These extra foods were reviewed and coded by a nutritionist using the FIAS. These extra foods can be used to add to the total nutrient intake described by the FFQ for specific research questions. Nutrients from the extra foods did not significantly change the FFQ intake estimates of the cohort participants and are not included in this analysis.

Data management/quality control. Data coding and entry of the FFQ were done in the laboratory of the UNCAHS. A set of quality control and coding rules was developed to ensure consistency and each decision was reviewed by the Nutrition Research Lab at Houston. Data were double entered and verified and then transmitted electronically to the Nutrition Research Lab at Houston for nutrient analyses. Nutrient analysis of the FFQ data was done using the Food Frequency Data Entry and Analysis Program [*48*]. Quality control review of the nutrient data was completed and letters were sent to each participant. The nutrient intake data

were electronically transmitted from Houston and merged with the master UNCAHS databases.

Data analyses. Descriptive statistics and graphical measures were used to describe the UNCAHS nutrient intake in both mass and nutrient density variables. Data were divided by gender and by levels of dietary total fat and vitamin A intake. Tertiles of dietary total fat were created to correspond to dietary recommendations with those consuming 30% of energy as the desirable level [*49*]. Four categories of vitamin A intake were used to correspond to dietary intake recommendations with the lowest category corresponding to 50% of the recommended dietary allowances (RDA) and the second category containing those consuming the minimum RDA (800 RE for women and 1,000 RE for men of this age range) [*50*]. Because the lowest category included only 33 people, results of this category are not presented in tables, only in the text. Those consuming vitamin A intakes in the upper two categories correspond to those with positive diet health behaviors. Differences in associations of chronic disease risk factors and health outcome variables within levels of dietary intake were tested and significance levels are included in tables.

RESULTS

Energy intake in this population as measured by the FFQ was on average 2,042 kcal/day for men and 1,903 kcal/day for women (Table 1). The significant differences in the nutrients unadjusted for energy are expected due to the caloric differences that exist between men and women. Men and women consumed similar intakes of macronutrients as evidenced by the nutrient density information in Table 1. Mean total fat intake was 32% kilocalories per day for men and 31% kilocalories per day for women with both consuming 11% of kilocalories per day from saturated fat. The average cholesterol intakes of men and women were also similar with 102 mg/1,000 kcal/day for men and 99 mg/1,000 kcal/day for women.

The FFQ assessed intake of alcohol as a beverage and from foods that were composed of recipes that had a small amount of alcohol. Thus, total alcohol intake is based on that from beverages and food. A total of 3,585 participants, 80.7%, reported consumption of alcohol as a beverage. The mean intake of alcohol in the cohort was higher for men, 12 g/day (range 0–161 g/day) compared to women, 6 g/day (range 0–86 g/day). This translates to about one drink per day for men and one-half a drink per day for women.

Women's diets were more nutrient dense than men's for all vitamins, with the exception of vitamin B12,

TABLE 1

Mean Macronutrient Intake and Nutrient Densities of the UNCAHS by Gender

Nutrient	Males n = 2,872 Mean	Males SD	Females n = 1,571 Mean	Females SD	P value
Energy (kcal)	2,042	601	1,903	635	0.0001
Protein (g)	76	27	73	29	0.0005
Carbohydrate (g)	260	94	254	91	0.0245
Total fat (g)	73	28	67	27	0.0001
Saturated fat (g)	25	10	22	9	0.0001
Monounsaturated fat (g)	27	11	24	10	0.0001
Polyunsaturated fat (g)	16	7	15	7	0.0001
Cholesterol (mg)	209	95	189	99	0.0001
Fiber (g)	20	8	20	8	0.1596
Alcohol (g)	12	16	6	10	0.0001
Protein (%kcal)	15	2	15	2	0.0001
Carbohydrate (%kcal)	51	7	53	7	0.0001
Total fat (%kcal)	32	6	31	6	0.0001
Saturated fat (%kcal)	11	2	11	2	0.0001
Monounsaturated fat (%kcal)	12	2	11	2	0.0001
Polyunsaturated fat (%kcal)	7	2	7	2	0.6291
Cholesterol (mg/1,000 kcal)	102	30	99	32	0.0014
Fiber (g/1,000 kcal)	10	2	11	1	0.0001
Alcohol (g/1,000 kcal)	4	5	2	4	0.0001

TABLE 2

Mean Micronutrient Intake and Nutrient Densities of the UNCAHS by Gender

Nutrient	Males n = 2,872 Mean	Males SD	Females n = 1,571 Mean	Females SD	P value
Vitamin A (RE)	1,536	799	1,718	891	0.0001
Alpha-carotene (μg)	970	759	1,174	915	0.0001
Beta-carotene (μg)	4,614	2,760	5,334	3,206	0.0001
Lycopene (μg)	5,072	4,235	5,319	4,024	0.0586
Lutein (μg)	3,684	2,548	3,870	2,648	0.0216
Folate (μg)	330	153	328	157	0.7475
Vitamin B_{12} (μg)	5	3	5	3	0.0001
Vitamin C (mg)	170	91	182	95	0.0001
Vitamin D (IU)	103	85	108	88	0.0888
Vitamin E (mg)	11	5	11	7	0.2249
Calcium (mg)	960	428	1,000	468	0.0038
Iron (mg)	16	7	15	7	0.0271
Selenium (mg)	69	28	66	25	0.0008
Caffeine (g)	143	121	117	103	0.0001
Vitamin A (RE/1,000 kcal)	761	328	912	373	0.0001
Alpha-carotene (μg/1,000 kcal)	485	359	629	430	0.0001
Beta-carotene (μg/1,000 kcal)	2,300	1,249	2,848	1,478	0.0001
Lycopene (μg/1,000 kcal)	2,512	1,829	2,823	1,948	0.0001
Lutein (μg/1,000 kcal)	1,828	1,130	2,060	1,283	0.0001
Folate (μg/1,000 kcal)	163	57	174	60	0.0001
Vitamin B_{12} (μg/1,000 kcal)	3	1	3	1	0.5082
Vitamin C (mg/1,000 kcal)	84	36	97	42	0.0001
Vitamin D (IU/1,000 kcal)	51	36	56	38	0.0001
Vitamin E (mg/1,000 kcal)	5	3	6	3	0.0016
Calcium (mg/1,000 kcal)	470	133	522	153	0.0001
Iron (mg/1,000 kcal)	8	2	8	2	0.0001
Selenium (mg/1,000 kcal)	34	10	35	10	0.0005
Caffeine (g/1,000 kcal)	74	64	66	77	0.0001

which was identical (Table 2). Women's nutrient densities of calcium and selenium were also higher, while caffeine was lower than men's. Men and women had similar intakes of iron.

Participants were divided into nutrient density categories of total fat intake using current dietary recommendations as a guide [*49*] (Table 3). Mean fat densities of these categories from low to high were 26, 34, and 40% of kilocalories per day, respectively. There was a gradient of increasingly higher nutrient intakes of saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, and caffeine across the groups. On the negative side was the fact that there was also a decreasing gradient of intake in 13 nutrients as the total fat density of the diet was greater. Nutrients that were lower in the higher fat intake groups were carbohydrates; fiber; alcohol; vitamins A, C, and D; alpha-carotene; beta-carotene; lycopene; lutein; folate; calcium, and iron. There was not an apparent difference in protein, selenium, and vitamins B12 and E across fat intake groups.

Selected risk factors within the categories of total fat intake are shown in Table 4. The majority of the UNCAHS consumed diets that were in the lower two categories of intake of total fat. Between 19 and 24% of participants consumed diets with high fat intake within each of the educational levels of the cohort.

A greater proportion of never smokers consumed diets with 30% of calories from fat than current smokers. The largest proportion of persons with diets high in total fat were among the current smokers, 35.7% compared to 18.7% of former smokers and 18.6% of never smokers.

The smallest percentage of persons categorized as having high-fat diets was among those who reported their current health to be excellent and good. The majority of the UNCAHS participants were mostly satisfied, pleased, or delighted with their life as a whole. Only 19.8% of alumni who were satisfied with their lives had high-fat diets.

Over half of the alumni were currently taking vitamin and mineral supplements, with the highest percentage of supplement takers in the low-fat intake group, 44%, compared to the high-fat intake group, 18.3%.

Categories of vitamin A intake were established to evaluate the quality of participants' diets that were very low and very high in vitamin A food sources (Table 5). The mean vitamin A intakes in categories from low to high were 274, 472, 638, and 935 RE/1,000 kcal/day, respectively. As vitamin A intake categories increased the overall quality of the diets was higher for 13 nutrients, carbohydrates; fiber; alpha-carotene; beta-carotene; lycopene; lutein; folate; vitamins B12, C, D, and E; calcium; and iron. Alumni with diets high in vitamin A were also lower in total fat, cholesterol, alcohol, and

TABLE 3

Mean Nutrient Densities by Categories of Total Fat Intake of the UNCAHS

	Total fat intake (% kcal)						
	0–30 n = 1,758		31–36 n = 1,779		37 + n = 906		
Nutrient	Mean	SD	Mean	SD	Mean	SD	P value
Protein (%kcal)	15	3	15	2	16	2	0.0001
Carbohydrate (%kcal)	57	7	51	4	44	4	0.0001
Total fat (%kcal)	26	3	34	2	40	3	0.0001
Saturated fat (%kcal)	9	2	11	1	13	2	0.0001
Monounsaturated fat (%kcal)	9	1	12	1	14	1	0.0001
Polyunsaturated fat (%kcal)	6	1	8	1	9	2	0.0001
Cholesterol (mg/1,000 kcal)	84	22	105	24	126	36	0.0001
Fiber (g/1,000 kcal)	11	3	10	2	9	2	0.0001
Alcohol (g/1,000 kcal)	4	6	3	4	2	3	0.0001
Vitamin A (RE/1,000 kcal)	911	397	786	319	683	258	0.0001
Alpha-carotene (μg/1,000 kcal)	602	449	514	361	451	300	0.0001
Beta-carotene (μg/1,000 kcal)	2,763	1,524	2,411	1,258	2,136	1,084	0.0001
Lycopene (μg/1,000 kcal)	2,806	2,244	2,514	1,548	2,478	1,646	0.0001
Lutein (μg/1,000 kcal)	2,035	1,269	1,870	1,151	1,748	1,087	0.0001
Folate (μg/1,000 kcal)	192	66	159	47	133	35	0.0001
Vitamin B12 (μg/1,000 kcal)	3	1	3	1	3	1	0.0001
Vitamin C (mg/1,000 kcal)	104	44	84	32	69	29	0.0001
Vitamin D (IU/1,000 kcal)	63	42	50	32	39	28	0.0001
Vitamin E (mg/1,000 kcal)	6	3	5	2	5	2	0.0105
Calcium (mg/kcal)	523	16	479	124	441	113	0.0001
Iron (mg/1,000 kcal)	9	3	8	2	7	1	0.0001
Selenium (mg/1,000 kcal)	35	10	34	9	34	9	0.0035
Caffeine (g/1,000 kcal)	69	65	71	75	76	65	0.0567

TABLE 4

Percentage of Persons[a] in Categories of Risk Factors by Total Fat Intake in the UNCAHS

Risk factor	Total fat intake (% kcal) 0–30	31–36	37 +	*P* value
Education				
Less than college degree	38.3	37.8	23.9	
	n = 181	*n* = 179	*n* = 113	
College degree	36.3	40.2	23.4	
	n = 298	*n* = 330	*n* = 192	
College degree or more	40.5	40.3	19.2	0.002
	n = 1,258	*n* = 1,254	*n* = 598	
Did you ever smoke cigarettes?				
Never	41.9	39.6	18.6	
	n = 874	*n* = 825	*n* = 387	
Used to or quit	40.6	40.7	18.7	
	n = 737	*n* = 739	*n* = 340	
Currently	25.0	39.3	35.7	0.000
	n = 112	*n* = 176	*n* = 160	
How would you rate your current health?				
Excellent	43.8	38.7	17.5	
	n = 980	*n* = 866	*n* = 391	
Good	36.5	41.9	22.5	
	n = 710	*n* = 834	*n* = 448	
Fair/Poor	32.4	32.4	35.1	0.000
	n = 58	*n* = 58	*n* = 63	
How do you feel about your life as a whole?				
Terrible & unhappy & mostly dissatisfied	36.5	39.6	23.9	
	n = 35	*n* = 38	*n* = 23	
Mixed	35.9	38.8	25.3	
	n = 163	*n* = 176	*n* = 115	
Mostly satisfied & pleased & delighted	40.2	40.0	19.8	0.000
	n = 1,546	*n* = 1,539	*n* = 761	
Are you currently taking supplements?				
Yes	44.1	37.6	18.3	
	n = 1,044	*n* = 889	*n* = 434	
No	34.3	42.9	22.7	0.000
	n = 698	*n* = 875	*n* = 463	

[a] Number of persons with missing information: education, 40; smoking, 93; rate health, 35; feel about life, 47; supplements, 40.

caffeine than alumni with low vitamin A intake. Five nutrients were almost the same across the levels of vitamin A intake, protein, saturated fat, monounsaturated fat, polyunsaturated fat, and selenium, although they were statistically different. The large sample size enhances the relatively small clinically relevant differences in these values.

Alumni were evaluated by several potential chronic disease risk factors within levels of vitamin A intake in Table 6. At least 60% of participants in each educational category consumed diets in the highest vitamin A category. The lowest proportion of people consuming high vitamin A diets were among the current smokers. Only 79.7% of the current smokers consumed at least the minimum RDA for vitamin A compared to 88.7% of the former smokers and 90.3% of the never smokers.

Between 65 and 68% of persons rating their current health as good or excellent consumed high levels of vitamin A. The proportion of people consuming levels of vitamin A intake were similar within the categories of participants perceptions about life as a whole.

Regardless of whether participants currently took vitamin and mineral supplements, the largest proportion of persons were in the high vitamin A intake category.

DISCUSSION

Overall the UNCAHS participants consumed a diet that was very close to that recommended by the current dietary guidelines for Americans, with the exception of calcium, which is low for both men and women [*49*]. The low intake of calcium puts the women in this cohort at increased risk for development of osteoporosis as they complete menopause and begin to make decisions

TABLE 5

Mean Nutrient Densities by Categories of Vitamin A Intake of the UNCAHS[a]

	Vitamin A Intake (RE)						
	401–800 n = 479		801–1,200 n = 982		1,201 + n = 2,949		
Nutrient	Mean	SD	Mean	SD	Mean	SD	P value
Protein (%kcal)	15	3	15	2	15	2	0.0001
Carbohydrate (%kcal)	50	8	50	7	53	7	0.0001
Total fat (%kcal)	33	6	33	6	31	6	0.0001
Saturated fat (%kcal)	11	2	11	2	11	2	0.0001
Monounsaturated fat (%kcal)	12	2	12	2	11	2	0.0001
Polyunsaturated fat (%kcal)	7	2	7	2	7	2	0.0032
Cholesterol (mg/1,000 kcal)	109	38	107	30	98	28	0.0001
Fiber (g/1,000 kcal)	8	2	9	2	11	2	0.0001
Alcohol (g/1,000 kcal)	5	7	4	5	3	4	0.0001
Vitamin A (RE/1,000 kcal)	472	136	638	167	935	357	0.0001
Alpha-carotene (μg/1,000 kcal)	266	138	375	185	637	429	0.0001
Beta-carotene (μg/1,000 kcal)	1,391	560	1,917	785	2,885	1,426	0.0001
Lycopene (μg/1,000 kcal)	2,057	1,358	2,426	1,552	2,790	2,025	0.0001
Lutein (μg/1,000 kcal)	1,192	690	1,634	933	2,132	1,263	0.0001
Folate (μg/1,000 kcal)	124	34	148	41	181	61	0.0001
Vitamin B_{12} (μg/1,000 kcal)	2	1	3	1	3	1	0.0001
Vitamin C (mg/1,000 kcal)	64	32	78	35	97	39	0.0001
Vitamin D (IU/1,000 kcal)	30	25	47	36	59	37	0.0001
Vitamin E (mg/1,000 kcal)	4	1	5	1	6	3	0.0001
Calcium (mg/1,000 kcal)	405	121	460	137	513	140	0.0001
Iron (mg/1,000 kcal)	7	1	7	2	8	3	0.0001
Selenium (mg/1,000 kcal)	34	11	35	10	34	9	0.7364
Caffeine (g/1,000 kcal)	95	78	83	69	62	55	0.0001

[a] 33 persons in the category of <400 RE are not shown in this table.

regarding use of estrogens [*16*]. Women's health issues are being tracked in the UNCAHS and the intake of calcium, use of hormones, and disease status will be carefully evaluated.

Many of the UNCAHS participants appear to be social drinkers with regular wine intake. Intake of red wine has been suggested to decrease risk of CVD when consumed in moderate amounts on a regular basis [*18*]. These dietary intake data will allow us to identify wine drinkers and as CVD endpoints are gathered, associations will be investigated. On the other hand, intake of alcohol has also been associated with increased risk of other chronic diseases, such as cancer [*17*]. Both quantity and types of alcohol will be evaluated in relation to chronic disease occurrence.

The public health message to consume diets containing 30% of energy from total fat appears to have reached this population more so than the general U.S. population. The average total fat intake of the UNCAHS participants is similar and slightly lower than that reported in the 1994–1996 CSFII for men and women of similar ages. In the 1994–1996 CSFII the percentage of men and women in this age range that met the dietary fat intake recommendations was 27.4% and 30.5%, respectively. Approximately 39% of the UNCAHS participants were in the recommended fat intake category indicating that perhaps the UNCAHS participants are more aware of the health benefits of lower fat intake than the general population.

In the 1994–1996 CSFII 41% of women and 40% of men met the RDA for vitamin A intake compared to 88% of this cohort. Because this population is highly educated and has the economic capability to purchase foods easily, it is hypothesized that they find it easy and desirable to consume fruits and vegetables that are the major sources of vitamin A. The impact of this positive behavior on future chronic disease risk will be monitored.

The interrelationship of fat intake and intake of other nutrients hypothesized to reduce risk of CVD is of interest since this population has overall a low total fat intake and high intakes of antioxidants, which have been hypothesized to reduce risk of CVD [*18*]. It was evident that those consuming higher fat diets had lower intakes of the protective antioxidants; thus these individuals may be at increased risk for developing CVD. These relationships will be explored as the endpoints are gathered. It was also evident from these data that alumni who had higher mean intakes of vitamin A had more nutrient-dense diets than those with lower vitamin A intake. Persons with higher vitamin A intake also had lower caffeine and cholesterol intake. These

TABLE 6

Percentage of Persons[a] in Categories of Risk Factors by Vitamin A Intake in the UNCAHS[b]

Nutrient	Vitamin A Intake (RE) 401–800	801–1,200	1201 +	*P* value
Education				
	12.1	25.8	61.5	
Less than college degree	*n* = 57	*n* = 122	*n* = 291	
	11.6	23.4	63.7	
College degree	*n* = 95	*n* = 192	*n* = 522	
	10.4	21.3	67.7	
College degree or more	*n* = 323	*n* = 662	*n* = 2,106	0.000
Did you ever smoke cigarettes?				
	9.3	21.1	69.2	
Never	*n* = 193	*n* = 441	*n* = 1,443	
	10.4	21.7	67.0	
Used to or quit	*n* = 189	*n* = 394	*n* = 1,217	
	18.5	28.8	50.9	
Currently	*n* = 83	*n* = 129	*n* = 228	0.000
How would you rate your current health?				
	10.1	21.4	68.0	
Excellent	*n* = 225	*n* = 479	*n* = 1,522	
	10.9	22.7	65.4	
Good	*n* = 217	*n* = 452	*n* = 1,303	
	16.8	25.1	56.9	
Fair/Poor	*n* = 30	*n* = 45	*n* = 102	0.004
How do you feel about your life as a whole?				
	11.5	21.9	66.7	
Terrible & unhappy & mostly dissatisfied	*n* = 11	*n* = 21	*n* = 64	
	14.3	22.9	61.9	
Mixed	*n* = 65	*n* = 104	*n* = 281	
	10.3	21.9	67.0	
Mostly satisfied & pleased & delighted	*n* = 396	*n* = 845	*n* = 2,577	0.000
Are you currently taking supplements?				
	9.4	20.8	69.2	
Yes	*n* = 222	*n* = 493	*n* = 1,639	
	12.3	23.7	63.0	
No	*n* = 250	*n* = 483	*n* = 1,283	0.000

[a] Number of persons with missing information: education, 40; smoking, 93; rate health, 35; feel about life, 47; supplements, 40.
[b] 33 persons in the category of <400 RE are not shown in this table.

combinations of behaviors may indeed afford a decreased risk of CVD and cancer for some persons. Siegler and associates [*23*] reported that in this cohort persons with higher hostility scores in college were more likely at follow-up to consume more caffeine, have a larger body mass index, have higher serum lipids, and be current smokers. Hostility was also associated with alcohol consumption. Thus the role of hostility and dietary factors will be instructive.

Exploration of selected chronic disease risk factors within categories of dietary intake suggests that current smokers have higher fat diets and lower vitamin A intake, factors which could increase risk for CVD and cancer. As well, never smokers had the lowest fat diets that will put them at reduced risk for many diseases. Current smokers are at the greatest risk of developing many cancers and they are the ones who are consuming the diets lower in vitamin A than both the former and the never smoking persons. Thus, these categories of vitamin A intake help to stratify this cohort by those who are exhibiting negative health behaviors. The greater proportion of current smokers consuming high-fat diets compared to the never smokers supports the notion that people who do not smoke are perhaps more health conscious than those who do smoke. This idea is further supported by the small proportion of persons with high-fat diets among those rating their current health very high. Categories of vitamin A intake did not seem to discriminate between how this cohort rated its health or perceived life. Recent research has begun to explore the factors that may influence healthful diets and overall health an area to which the UNCAHS has the potential to contribute [*51*,*52*].

The overall high percentage of persons in this cohort taking supplements is not unexpected. Estimates of the prevalence of supplement use in the general population are about 35–40% [*53*]. However, in this upper- and middle-income, highly educated cohort the prevalence

was 54%. Other studies have reported that higher educated people take more supplements than those with less education [*54*]. A recent study of 1,449 persons in Washington State indicated that supplement users were more likely to exercise, consume a low-fat diet, and eat fruits and vegetables, behaviors which are associated with a chronic disease prevention risk approach [*55*]. Supplement usage did not differ by intake levels of vitamin A among the UNCAHS participants.

More alumni who rated their current health as excellent or good had low-fat intake and high vitamin A intake than those in other categories. More than half of the alumni were supplementing their diets with vitamins, minerals, and other nutritional supplements on a regular basis. It seems that those eating low-fat, high-vitamin-A diets are the ones that are also supplementing their diets the most. This will provide a particularly rich set of information to follow prospectively and integrate with disease endpoints. The supplement information has been coded by brand name and with specific nutrients to allow the role of supplements to be investigated independently as well as additively with the FFQ intake data. Recent reports are conflicting regarding the protective roles of food and supplement sources of some nutrients. The UNCAHS will be able to address intake from both sources with disease endpoints.

As this large cohort ages, it is possible that many of them will approach the time period of greatest risk for chronic disease with less risk than many Americans. The data being tracked in the UNCAHS will allow the investigation of the psychosocial correlates of persons to facilitate understanding of the behavior of persons who do and do not follow suggested dietary recommendations to reduce risk of chronic disease.

APPENDIX FOOD LIST FROM UNCAHS FOOD FREQUENCY QUESTIONNAIRE, 1995–1996

1. Oranges or tangerines
2. Apples or pears
3. Applesauce
4. Banana
5. Cantaloupe
6. Watermelon
7. Grapes
8. Peaches or nectarines
9. Strawberries
10. Grapefruit
11. Mixed fruit salad
12. Prunes
13. Raisins
14. Calcium-fortified orange juice
15. Orange, grapefruit, or cranberry-type juice
16. Grape, apple, or prune juice
17. Kool-Aid, Wylers, Country Time lemonade, or Crystal Light
18. Hi-C or Hawaiian Punch
19. Other fruit-flavored drinks
20. V-8-type vegetable juices
21. Raw tomatoes
22. Broccoli
23. Carrots
24. Cauliflower
25. Cabbage or coleslaw
26. Corn
27. Green beans or green peas
28. Kale, mustard, collard, turnip, or chard greens
29. Raw spinach
30. Cooked spinach
31. Sweet potatoes, yams, or pumpkin
32. Acorn or butternut squash
33. Summer squash—Yellow or zucchini
34. Vegetable combo cooked or raw (one green or yellow)
35. Lettuce or lettuce salad with any vegetables
36. Mayonnaise or creamy salad dressing
37. Oil and vinegar or Italian-type dressing
38. Reduced calorie or no-fat salad dressing
39. Tofu or soybeans
40. Beans or lentils
41. Refried beans
42. Potato salad
43. Fried potatoes
44. Boiled or mashed potatoes
45. Baked potatoes
46. Garlic, fresh or powdered
47. Raw or cooked sweet red peppers
48. Raw or cooked sweet green or yellow peppers
49. Green hot chili peppers (jalapenos)
50. Picante sauce or salsa
51. Spaghetti with tomato sauce or meat sauce
52. Lasagna, cannelloni, or ziti
53. Macaroni or other pasta with cheese
54. Pasta salad or macaroni salad with or without meat
55. Fried rice
56. Brown, white, or mixed rice
57. Egg roll
58. Chicken, turkey, or seafood casserole
59. Beef stew, beef casserole, or goulash
60. Vegetable, tomato, noodle, or broth soup
61. Cream soup
62. Nachos
63. Taco or tostada
64. Enchilada or burrito
65. Chili con carne
66. Pizza or calzone
67. Hamburger
68. Cheeseburger
69. Meat sandwiches without cheese (club, subs, etc.)

70. Meat sandwiches with cheese (club, subs, etc.)
71. Peanut butter or peanut butter sandwich
72. Tuna or tuna salad sandwich
73. Fried fish, battered, or breaded
74. Raw or cooked oysters
75. Canned salmon or sardines
76. Fresh mackerel, salmon, bluefish, or swordfish
77. White meat fish (trout, perch, flounder, etc.)
78. Shrimp, lobster, crab, or scallops as a main dish
79. Hot dog, corn dog, or kosher frank
80. Bacon
81. Beef or pork sausage (country sausage, bratwurst, etc.)
82. Beef, pork, or lamb as a main dish (roast, ham, chops, etc.)
83. Fried chicken
84. Baked or broiled chicken or turkey
85. Eggs or omelets
86. Total, Most, Product 19, King Vitamin, or Just Right Cereal
87. All other dry cereal
88. Low-fat or skim milk with cereal
89. Whole milk with cereal
90. Cooked cereal
91. Pancakes, waffles, or french toast
92. Doughnuts, sweet rolls, or croissants
93. Biscuits
94. Bagels
95. Cornbread
96. Garlic bread
97. Bread, toast, or rolls (not in a sandwich)
98. Tortillas
99. Crackers
100. Granola bars or breakfast bars
101. Skim milk or buttermilk
102. Low-fat or 2% milk
103. Whole milk
104. Liquid meals such as Slimfast, Sego, or Dynatrim
105. Hot cocoa or chocolate
106. No-fat or low-fat yogurt
107. Frozen yogurt, ice milk, or low-fat ice cream
108. Chocolate ice cream or ice cream bar
109. Other flavors of ice cream or ice cream bar
110. Chocolate pudding
111. Other pudding
112. Sour cream (regular and low fat)
113. Low-fat cream cheese
114. Regular cream cheese
115. Cottage cheese (regular and low fat)
116. Light margarine or spreads
117. Margarine or spreads
118. Butter
119. Mozzarella cheese
120. Swiss, Monterey jack, or provolone cheese
121. Cheddar or American cheese
122. Processed cheese
123. Tortilla or corn chips
124. No-fat tortilla or corn chips
125. Potato chips
126. Pretzels
127. Almonds
128. All Other Nuts (peanuts, pecans, mixed nuts, etc.)
129. Popcorn—low fat or no fat
130. Popcorn–with fat added
131. Cookies and brownies
132. Cake
133. Fruit pies or cobbler
134. Custard or cream pie
135. Chocolate candy
136. Hard or chewy sugar candy
137. Low-calorie cola, e.g., Tab, with caffeine
138. Low-calorie, caffeine-free cola, e.g., Pepsi Free
139. Other low-calorie carbonated drink, e.g., diet 7-UP
140. Coke, Dr Pepper, or other cola with sugar
141. Caffeine Free Coke, Dr Pepper, or other cola with sugar
142. Other carbonated drink with sugar, e.g., 7-UP
143. Coffee, hot or iced
144. Decaffeinated coffee, hot or iced
145. Hot caffeinated tea, sweetened or unsweetened
146. Iced caffeinated tea, sweetened or unsweetened
147. Heavy cream or whipping cream
148. Half and half or light cream
149. Cream substitute
150. Beer
151. Red wine
152. Other wine
153. Liquor or mixed drinks

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