UC Berkeley

UC Berkeley Previously Published Works

Title

Food intake characteristics of hemodialysis patients as obtained by food frequency questionnaire.

Permalink

<https://escholarship.org/uc/item/34j6z7ph>

Journal

Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation, 12(1)

ISSN

1051-2276

Authors

Kalantar-Zadeh, Kamyar
Kopple, Joel D
Deepak, Sunaina
et al.

Publication Date

2002

DOI

10.1053/jren.2002.29598

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

Food Intake Characteristics of Hemodialysis Patients as Obtained by Food Frequency Questionnaire

Kamyar Kalantar-Zadeh, MD, MPH,* Joel D. Kopple, MD,†
Sunaina Deepak, MS, RD,‡ Donald Block, MD,§ and Gladys Block, PhD||

Objectives: Food frequency questionnaires (FFQ) are frequently used in epidemiologic studies of nutrition and food intake. However, the use of FFQs in patients receiving maintenance dialysis has not been extensively studied. We hypothesize that FFQ is a useful tool to assess the food intake differences between patients receiving dialysis and patients not receiving dialysis.

Design: Matched exposed-unexposed study with case-controlled design.

Setting: Outpatient dialysis unit affiliated with a tertiary-care community medical center.

Patients: From a pool of 102 maintenance hemodialysis (MHD) outpatients in a community dialysis unit, 30 adult MHD outpatients (15 men, 15 women, aged 55.8 ± 14.6 years) were selected randomly as case subjects. They included 16 African Americans, 8 whites, 4 Hispanics, and 2 Asians. Eleven MHD patients took the multivitamin, Nephrovite (R&D Laboratories, Marina del Rey, CA), regularly. From an archive of 1,610 nondialytic individuals with known FFQ data, 30 control subjects were selected randomly to match the age, race, and sex of the case subjects.

Intervention: We used Block's FFQ (version 98), an 8-page self-administered questionnaire that has been widely used in epidemiologic studies. A group of trained research assistants supervised the FFQ administration and interviewed those patients who were not able to answer all of the questions without assistance. Student *t* test was used to compare group means in form of daily dietary intake, and conditional logistic regression was used to calculate odds ratios for predetermined dichotomizing cutoff levels.

Main outcome measures: Food intake characteristics of MHD patients as compared with control patients not receiving dialysis.

Results: Statistically significant differences between MHD case subjects and nondialytic control subjects were observed between the amounts of daily intake for vitamin C (84 ± 63 mg/d v 127 ± 70 mg/d, $P = .01$), dietary fiber (12 ± 6 g/d v 18 ± 11 g/d, $P = .02$), potassium ($2,024 \pm 1,088$ mg/d v $2,701 \pm 1,429$ mg/d, $P = .04$), cryptoxanthin (56 ± 88 μ g/d v 140 ± 118 μ g/d, $P = .003$), and lycopene ($2,052 \pm 2,234$ μ g/d v $4,524 \pm 3,979$ μ g/d, $P = .004$). These data indicate that MHD patients had a significantly lower intake of vitamin C, dietary fibers, potassium, and 2 of the carotenoid compounds when compared with individuals not receiving dialysis. Moreover, the daily intake of vitamin B₆ was significantly higher in MHD patients probably because of the high pyridoxine content in

*Assistant Clinical Professor of Medicine, University of California-Los Angeles School of Medicine, Los Angeles, CA; Associate Director of Transplant Program, Harbor-UCLA Medical Center, Torrance, CA.

†Professor of Medicine and Public Health, University of California-Los Angeles Schools of Medicine and Public Health, Los Angeles, CA; Director, Division of Nephrology and Hypertension, Harbor-UCLA Medical Center, Torrance, CA.

‡Dialysis Unit Dietitian, Fresenius Medical Care, Berkeley, CA.

§Attending Nephrologist, East Bay Nephrology Medical Group, Berkeley, CA.

||Professor of Epidemiology and Public Health, Director, Public Health Nutrition, University of California Berkeley School of Public Health, Berkeley, CA.

Supported in part by grant DK61162 from the National Institute of Digestive, Diabetes and Kidney Diseases for Nutritional and Inflammatory Evaluation of Dialysis Patients Study (NIED Study).

Presented at the 9th Annual National Kidney Foundation Clinical Meeting, held in Atlanta, GA, April 2000.

Address reprint requests to Kamyar Kalantar-Zadeh, MD, MPH, Harbor-UCLA Medical Center, Division of Nephrology and Hypertension, 1000 W Carson St, Harbor Mailbox 406, Torrance, CA 90509. E-mail: kkalantar@rei.edu

© 2002 by the National Kidney Foundation, Inc.

1051-2276/02/1201-0003\$35.00/0

doi:10.1053/jren.2002.29598

Nephrovite. By using the conditional logistic regression analysis, the odds ratios for lower than predetermined cutoff levels in patients receiving dialysis were significant for vitamin C, potassium, and the 2 previously mentioned carotenoids (odds ratio between 3.50 and 7.50, $P < .05$).

Conclusions: Patients receiving dialysis may consume significantly lower amounts of potassium, vitamin C, and dietary fibers as well as lower amounts of some carotenoids. The FFQ seems to be a useful tool to compare dietary intake of MHD patients with other groups, although it may underestimate the amount of daily protein and energy intake and, hence, may not be an accurate tool for individual assessment of food intake. More studies are required to evaluate the validity of the FFQ in dialysis patients. The lower vitamin C, fiber, and carotenoid intake of MHD patients may be atherogenic. Hence, the hypothesis is proposed that prescribed restrictions in potassium in MHD patients may lead to reduced fruit and vegetable intake, leaving meat and fats as the main source of calories. This may contribute to atherosclerosis and increased cardiovascular morbidity and mortality in these patients. This hypothesis needs to be evaluated in future studies.

© 2002 by the National Kidney Foundation, Inc.

MALNUTRITION OCCURS at high prevalence in conjunction with end-stage renal disease (ESRD) patients who undergo maintenance hemodialysis (MHD) treatment and may be a risk factor for increased morbidity and mortality in these patients.¹⁻³ It is generally believed that the quality and quantity of food intake in MHD patients may play a major role in the development of the dialysis-associated malnutrition and the subsequent complications, such as an increased risk of cardiovascular disease.^{4,5}

Food frequency questionnaires (FFQ) have been used extensively in epidemiologic studies to evaluate the characteristics of food intake among diverse populations.⁶⁻⁹ However, the use of FFQs in dialysis patients has not been well studied. We used Block's FFQ (version 98), an 8-page self-administered questionnaire widely used in epidemiologic studies, in a group of patients on hemodialysis and compared the results with a group of control individuals without any known kidney disease. We hypothesized that the FFQ is a useful tool to assess the food intake differences between the dialysis and nondialysis populations. Moreover, we examined the hypothesis that MHD patients have low intake of various essential nutrients when compared with nondialytic individuals.

Methods

Case Subjects (MHD Patients)

The outpatient chronic dialysis unit of Fresenius Medical Care in Berkeley, CA, under the care of East Bay Nephrology Medical group, treated 102 adult MHD outpatients at the time of the study, who all resided in the San Francisco

Bay area. For this study, inclusion criteria were age between 18 and 80 years, uninterrupted thrice-weekly MHD treatment for at least 6 months, ability to read and understand English or Spanish adequately to answer the food intake questions, and ability to ingest food independently at least 3 times a day. Patients who had major debilitating diseases, including acquired immunodeficiency syndrome, severe (stage III or IV) congestive heart failure, severe lung disease, or terminal malignancies, were excluded. Other exclusion criteria were hospitalization in the last 3 months except for dialysis access-related admissions, inability to ingest regular solid food, major psychiatric diseases or severe dementia, and gastrointestinal or neurologic diseases that interfered with food ingestion. Out of 41 eligible MHD patients, 32 individuals agreed to enroll into the study and participated in the preliminary interview, including answering the food intake questions. Two patients did not complete the questionnaires despite multiple approaches by the interviewers and were withdrawn from the study. Hence, 30 MHD outpatients (15 men, 15 women) were studied. Ages ranged from 27 to 80 years (mean $\pm$ SD, 55.8 ± 14.6 years) and the vintage (duration of chronic intermittent dialysis therapy) varied from 6 months to 10 years (42 ± 29 months). They included 16 African Americans, 8 whites, 4 Hispanics, and 2 Asians. The dry body weight (69.1 ± 19.6 kg) was the average edema-free weight immediately at the end of the hemodialysis sessions.

Controls

To select controls subjects for the study cases, an archive of 1,610 individuals who were not

known to have kidney diseases and were not undergoing hemodialysis treatment were used. The archive included data on food intake by using the same FFQ used for the case subjects from several epidemiologic studies. All control individuals resided in the San Francisco Bay area. The data pool included the detailed FFQ results of the controls along with demographic data including age, sex, and race, as well as weight and height at the time of the FFQ evaluation of each individual. The control list was randomized, then sorted according to the age (continuous variable), with secondary and tertiary sorting by sex and race (African American, white, Hispanic, Asian, and others), respectively. For each case, a control was sought by reviewing the previously mentioned control pool from the beginning of the list to match for age within 5-year intervals (MHD patient's age $\pm$ 2.5 years), sex, and race. The first control-pool individual who met all 3 of the previously mentioned matching criteria was selected as the matched control for the case in question. Hence, 30 matched controls were selected through the previously mentioned approach and each control subject was matched to 1 case subject (MHD patient) in terms of age, sex, and race.

Block's FFQ

The full-length dietary questionnaire, also known as the Block FFQ, was originally developed by Gladys Block, PhD, at the National Cancer Institute for research into the role of diet in health and disease and has been continually updated and improved.^{7,8} The different versions of this questionnaire have been developed in a scientific and data-based approach, and have been extensively studied and validated.⁷⁻⁹ The Block 98 version (developed by Block Dietary Data Systems and distributed by Nutritionquest.com, both located in Berkeley, CA) is an 8-page paper and pencil form that one can complete at home or during outpatient visits, such as hemodialysis sessions, in about 20 to 40 minutes. The FFQ includes more than 150 multiple-choice questions based on 107 food items. The first 5 questions are general inquiries concerning types of fruits, vegetables, cereal, and fat or oil that are ingested. Seventeen subsequent questions are about vitamins and minerals that have been taken regularly, such as multivitamins, including Centrum or Thera-type vitamins (Whitehall-Robins

Healthcare, Madison, NJ), or herbal supplements such as ginkgo, ginseng, and so on. The next 130 items are detailed questions about food intake habits and provide extensive coverage. They ask how often a person consumes around 100 common foods. Each of these questions has 2 sets of multiple-choice answers. The first set is about the frequency of the given food item and has up to 9 options from never to every day. The second set pertains to the quantity of the ingested food and has 4 distinct levels from which to choose. At the end, there are 9 additional questions about the general impressions and opinions of the responder with regard to the questionnaire as a whole.

The completed FFQ forms undergo a fast and convenient computer analysis and the results become available in user-friendly formats. The FFQ report includes the following items: (1) the average individual intake and the recommended levels of macronutrients (calories, fat, saturated fat, monounsaturated fat, polyunsaturated fat, percent of calories from fat, protein, carbohydrates, cholesterol, fiber), antioxidants (vitamin A, beta-carotene, vitamin C, vitamin E), B-vitamins (vitamin B₁, B₂, folic acid, B₆, niacin), minerals (calcium, sodium, potassium, iron, zinc), food group servings (fruits, vegetables, dairy, meats, grains, fats and sweets), and nutrients from vitamin supplements, if taken; (2) the individual's top 3 dietary sources of calories, fat, saturated fat, sodium, beta-carotene, folate, and vitamin C; and (3) personalized suggestions for improving nutrition based on the individual's own reported intake (Tables 1 and 2). The Block FFQ can be either self-administered or administered by interview.

In this study, a group of trained research assistants supervised the FFQ administration while the 30 MHD patients were undergoing routine hemodialysis treatment thrice weekly in the hemodialysis unit. The research assistants were undergraduate students from the University of California, Berkeley, who underwent an intensive training course by a nutritional epidemiologist (Dr G. Block) and a nephrologist (Dr Kalantar) before the study. They interviewed and assisted those patients who were not able to answer all questions. The completed FFQ booklets were reviewed immediately after they were returned, and if any question remained unanswered, the FFQ was returned to the patient with the request to attempt to answer the blank questions. The time required to complete the

Table 1. Nutrient and Food Group Estimates Resulting From Analysis of the Block 98 FFQ

Daily Nutrients From Food	Demographic Data	Nutrients From Vitamin Supplements
Calories	Identification	Vitamin A
Protein	Sex	Vitamin C
Total fat	Age	Vitamin D
Carbohydrate	Race/ethnicity	Vitamin E
Calcium	Weight	Iron
Phosphorus	Height	Calcium
Iron	Language usually spoken	Zinc
Sodium	Pregnant/breastfeeding	Beta-carotene
Potassium	Current smoking	B ₁ or B ₂
Vitamin A (IU)	Self-assessed health status	B ₆
Vitamin A (RE)	Number of times on a weight-loss diet	B ₁₂
Thiamin (B ₁)	How like meat cooked	Folate
Riboflavin		Copper
Niacin		Selenium
Vitamin C	Percent of Calories	Years each supplement taken
Saturated fat	% Fat	
Oleic acid	% Protein	
Linoleic acid	% Carbohydrate	Fiber From Different Sources
Cholesterol	% from sweets, desserts	From Beans
Dietary fiber	% from alcoholic beverages	From Vegetables and Fruits
Folate		From Grains
Vitamin E	Percent of Kcal and Cals From Alcoholic	
Zinc	Beverages Excluded From	Outlier Flags
Animal zinc	Denominator	Initially
Vitamin B ₆	% Fat cal, without alcohol	After portion size adjustment
Magnesium	% Protein cal, without alcohol	
Alpha-carotene	% Carbohydrate cal, without alcohol	Quality Flags
Beta-carotene		Number of foods skipped
Cryptoxanthin	Food Group Frequencies per Day	Number of solid foods/day
Lutein	Vegetables	Number of smalls, mediums, larges
Lycopene	Fruit and fruit juice	Number never eaten
Retinol	Breads, cereals, rice, pasta	Number of edit warnings
"Carotene"	Milk, yogurt, cheese	Number of edit serious errors
Vitamin D	Meat, fish, poultry, beans, eggs	
Phytoestrogens	Fats & oils	
	Yellow and leafy green vegetables	Grams of Solid Food
	Citrus fruits/juices	

FFQ varied between 20 and 55 minutes. Two patients were Spanish speaking and, because the Spanish version of the FFQ was not available at the time of the study, Spanish-speaking interviewers interpreted all questions for these 2 patients.

All FFQs were scanned at the end of the study by using an optical mark reader scanner and the results were interpreted by using a software specifically designed to analyze the FFQ information based on food ingredient data from the United States Department of Agriculture. The same Block 98 FFQ and analysis system was used to obtain data from the nondialytic individuals of the previously mentioned control pool. A sample of the results, as produced by the analysis, can be seen in the appendix.

It should be noted that the Block FFQ is not specifically designed for the dialysis patients.

Hence, dialysis-specific medications, such as calcium acetate, or multivitamins that are usually administered to dialysis individuals, such as Nephrovite (R&D Laboratories, Marina del Rey, CA), have not been accounted for accurately. In this study, all 11 patients who were taking Nephrovite were asked to answer positively a similar question concerning the intake of another multivitamin (Centrum). Hence, the computerized data analysis of Nephrovite intake was based on Centrum intake. However, Centrum or other Thera-type over-the-counter multivitamins have slightly different components when compared with Nephrovite, which is devoid of vitamin A and beta-carotene, has more vitamin B₆ (10 mg instead of 2 mg in Centrum), and folic acid (800 to 1,000 μ g instead of 400 μ g). Hence, the intake amount of these 4 nutrients (vitamin A, beta

Table 2. The Process of Computerized Analysis of the Final Report of the Block's FFQ (Version 1998)

Type of Error	Warning Level	Error Level	Comment
Too many food questions skipped	10 items	15 items	Skipping a few is generally benign, and often represents foods rarely eaten.
Too many coded using same frequency column	70%*	None	Percent of validly marked foods. This may catch persons who just marked down a column without thinking about their diet. When many are in column 1, it may also identify a person for whom the questionnaire does not represent the foods in his/her diet.
Too many coded as small	75%*	None	Percent of foods eaten that are marked small. Age- and sex-specific portion sizes already take account of portion size differences caused by those factors; persons who mark too many smalls will get an incorrectly low nutrient estimate as a result. This is partially handled by an option changing small to medium if the energy estimate is below an age-or sex-specific cutpoint.
Too many coded as medium	94%*	None	Percent of foods eaten. All mediums indicate a person not trying very hard. Better estimates result if some smalls and larges are used.
Too many coded as large	75%*	None	Percent of foods eaten. Young men may choose too many larges, giving an exaggerated nutrient estimate.
Too many foods per day	(None)	25 food servings	Number of servings of solid foods, excluding beverages and condiments. This will rarely occur with Block 95.
Too few foods per day	<4	<3	Number of servings of solid foods, excluding beverages and condiments.
Questionably high food frequencies	—	—	Implausibly high reported frequencies of individual foods cannot occur in Block 95.

**"Edit Report."* Before nutrient analysis, the scanned file is examined by computerized editing to identify responses that appear questionable. If an individual questionnaire contains questionable data, all errors and warnings for that questionnaire are listed. You will receive this printable edit report for all questionnaires on the file. The possible error/warning messages for the food list, and the levels that cause a warning or error message, are shown in the table. (Different cut-points for the error and warning levels are possible.) *"Warning."* This alerts you to possibly questionable data. *"Error."* Persons whose responses exceed the defined error level are flagged on the Edit Report as "Severe Error." If possible, these persons should be queried and their responses corrected. If that is not possible, it may be advisable to exclude them from some analyses. This is particularly the case with "too many foods skipped." For other causes of severe error, such as "Too Few Foods," you should use your own judgment about the extent to which you are concerned about them.

carotene, vitamin B₆, and folate) was recalculated in all patients who were taking Nephrovite. Nevertheless, other components of these 2 multivitamin types (vitamins C, D, E, K, B₁₂, thiamin, riboflavin, niacin, and biotin) are the same.

Epidemiologic and Statistical Methods

We conducted a one-to-one matched exposed-unexposed study with case-control design.¹⁰ The main exposure was dialysis treatment and the outcome was nutrient data as obtained by the FFQ. The food intake data were initially analyzed as continuous variables. If significant differences between cases and controls were observed, the variables in question were dichotomized.

To dichotomize the data, the most acceptable, rounded cut-off level that was able to generate the lowest *P* value in the conditional logistic regression model was explored among some conventional cut-off levels. We used Student *t* test (2-tailed) for group mean comparisons of continuous variables among case subjects and control subjects. Shapiro-Wilk test was used to assess the normality. Conditional logistic regression analysis was used to calculate the odds ratios (OR) and their 95% confidence intervals (CI) for dichotomized variables comparing case subjects (exposed) with control subjects (unexposed), who were matched for age, sex, and race. Descriptive and analytical statistics were carried out with the statistical software Stata, version 5.0 (Stata, College Station, TX). Continuous vari-

Table 3. Demographic and Anthropometric Characteristics of Case Subjects (Maintenance Hemodialysis Patients) and Control Subjects (Nondialytic Population)

Variable	Case Subjects (MHD Patients)	Control Subjects	P
Number	30	30	N/A
Male to female ratio	15:15	15:15	N/A
African Americans	16	16	N/A
Whites	8	8	N/A
Hispanics	4	4	N/A
Asians	2	2	N/A
Age (y)	55.7 ± 14.6	55.6 ± 14.4	.96
Weight (kg)	67.5 ± 17.9	76.1 ± 19.7	.08
Height (m)	1.64 ± 0.14	1.68 ± 0.11	.18
BMI (kg/m ²)	25.1 ± 6.0	26.9 ± 6.3	.25
Dialysis months	42 ± 29	N/A	N/A
BMI (kg/m ²)	25.1 ± 6.0	26.9 ± 6.3	.25
Dialysis months	42 ± 29	N/A	N/A
Kt/V	1.35 ± 0.24	N/A	N/A
nPNA (g/kg/d)	1.12 ± 0.21	N/A	N/A
Serum albumin (g/dL)	3.81 ± 0.53	N/A	N/A
Serum TIBC (mg/dL)	184 ± 33	N/A	N/A

Abbreviations: BMI, body mass index; TIBC, total iron binding capacity; nPNA, normalized protein equivalent of total nitrogen appearance.

ables are given as the mean ± standard deviations. A value of $P < .05$ is considered to be statistically significant.

Results

Table 3 shows the demographic and anthropometric characteristics of case subjects (MHD patients) and control subjects. Control subjects were, on average, 8.6 kg heavier and 4 cm taller than the case subjects, but these differences did not approach statistical significance. The body mass index of the case subjects (25.1 ± 6.0 kg/m²) was slightly lower than that of control subjects (26.9 ± 6.3 kg/m²), but no statistical significance was observed ($P = .25$). The MHD patients underwent hemodialysis for 3 to 4.5 hours thrice weekly. Their Kt/V was 1.35 ± 0.24 (mean ± SD). Their normalized protein equivalent of total nitrogen appearance was 1.12 ± 0.21 g/kg/d, their serum albumin level was 3.81 ± 0.53 g/dL, and serum total iron-binding capacity was 184 ± 33 mg/dL.

Table 4 lists the food intake results of the case and control subjects as obtained by analyzing the FFQ data. Nine MHD patients took Nephrovite every day and 2 MHD patients took it 4 to 5 times per week. The MHD outpatients had lower total calorie, protein, fat, and carbohydrate intake when compared with nondialytic controls, but the differences were not statistically significant. When

these measures were normalized for weight, the calorie density and protein density intake of MHD patients and controls were similar (26.4 ± 15.3 cal/kg/d v 25.3 ± 10.9 cal/kg/d and 0.88 ± 0.57 g/kg/d v 0.85 ± 0.40 g/kg/d, respectively). In MHD patients, mineral intake appeared to be lower, among which only total daily potassium showed statistically significant differences. The MHD patients took $2,024 \pm 1,088$ mg/d of potassium, whereas the control subjects' intake of potassium was approximately 30% greater (ie, $2,701 \pm 1,429$ mg/d, $P = .04$). Among lipids, the MHD patients had greater daily intake of cholesterol but lower daily intake of saturated fat, oleic acid, and linoleic acid when compared with the control subjects, although these differences were not statistically significant. There was a statistically significant difference between the amount of dietary fiber intake in the MHD cases (12.4 ± 5.8 g/d) when compared with that in control subjects (17.9 ± 10.6 g/d), denoting that dialysis patients consume less amounts of fiber in their diet ($P = .02$). The MHD patients ingested lower amounts of vitamins when compared with controls. The statistically significant differences between the MHD cases and nondialytic controls were observed for the daily intake of vitamin C (84 ± 63 mg/d v 127 ± 70 mg/d, $P = .01$) and 2 carotenoids, cryptoxanthin (56 ± 88 μg/d v 140 ± 118 μg/d, $P = .003$) and lycopene

Table 4. Food Intake Components in 30 Case Subjects (Maintenance Dialysis Patients) and 30 Control Subjects (Nondialytic Individuals), According to FFQ Results (Matched for Sex, Race, and Age)

Variable	Cases (MHD pts)	Controls	P	Comments*
Total calories (cal)	1,604 ± 716	1,881 ± 833	.17	Varies
Calorie density (cal/kg)	26.4 ± 15.3	25.3 ± 10.9	.76	Varies
Total protein (g)	53.7 ± 28.6	63.6 ± 33.4	.22	0.80 g/kg
Protein density (g/kg)	0.88 ± 0.57	0.85 ± 0.40	.76	0.80 g/kg
Total fat (gm)	63.9 ± 35.1	72.7 ± 34.0	.33	<.034 × nonalcohol calories
Carbohydrate (g)	203.2 ± 84.4	244.6 ± 121.2	.13	0.125-0.150 × nonalcohol calories
Calcium (mg)	530 ± 350	668 ± 457	.19	Teens, 1,300 mg; 19-50, 1,000 mg; 51+, 1,200 mg
Phosphorus (mg)	903 ± 468	1,062 ± 616	.27	Teens, 1,300 mg; 19-50, 1,000 mg; 51+, 1,200 mg
Iron (mg)	12.4 ± 7.3	13.4 ± 7.4	.59	Varies
Sodium (mg)	2,144 ± 1,269	2,310 ± 1,079	.59	500-2,400 mg
Potassium (mg)	2,024 ± 1,088	2,701 ± 1,429	.04†	2,000-3,500 mg or more
Vitamin A (IU)‡	7,256 ± 6,988	8,662 ± 8,775	.35	Men, 5,000 IU; women, 4,000 IU
Thiamin (B ₁) (mg)	1.22 ± 0.78	1.37 ± 0.63	.40	Men, 1.2 mg; women, 1.1 mg
Riboflavin (B ₂) (mg)	1.43 ± 0.94	1.56 ± 0.89	.56	Men, 1.3 mg; women, 1.1 mg
Niacin (mg)	15.88 ± 9.41	19.16 ± 9.58	.19	Men, 16 mg; women, 14 mg
Vitamin C (mg)	83.5 ± 63.0	127.1 ± 70.0	.01†	100 mg or more, especially for smokers
Saturated fat (g)	18.1 ± 10.5	21.5 ± 10.9	.23	Approximately 1/3 of fat
Oleic acid (g)	23.85 ± 13.08	27.08 ± 13.49	.35	Approximately 1/3 of fat
Linoleic acid (g)	16.7 ± 9.6	18.4 ± 8.4	.47	Approximately 1/3 of fat
Cholesterol (mg)	259 ± 170	209 ± 144	.23	<300 mg
Fiber (g)	12.4 ± 5.8	17.9 ± 10.6	.02	20-35 g
Folate (μg)‡	454 ± 247	363 ± 215	.47	400 μg/d; if pregnant, 600 μg/d
Vitamin E (mg)	8.85 ± 7.30	8.49 ± 3.75	.81	Men, 10 mg; women, 8 mg a-TE
Zinc (mg)	10.09 ± 7.56	9.62 ± 6.56	.80	Men, 15 mg; women, 12 mg
Vitamin B ₆ (mg)‡	3.95 ± 0.87	1.73 ± 0.94	.001†	Adults, 1.3 mg, age 51+; men, 1.7 mg; Women, 1.5 mg
Magnesium (mg)	204 ± 111	272 ± 149	.05	Men, 350 mg; women, 280 mg
Alpha carotene (μg)	758 ± 981	707 ± 846	.83	A carotenoid, no range set
Beta carotene (μg)‡	2,262 ± 2,866	3,240 ± 3,530	.19	A carotenoid, no range set
Cryptoxanthin (μg)	56 ± 88	140 ± 118	.003†	A carotenoid, no range set
Lutein (μg)	1,003 ± 787	1,999 ± 2,649	.05†	A carotenoid, no range set
Lycopene (μg)	2,052 ± 2,234	4,524 ± 3,979	.004†	A carotenoid, no range set
Retinol (μg)	449 ± 432	462 ± 471	.91	Preformed vitamin A, approximately 500-800 μg
Pro-carotenes (μg)	3,906 ± 3,673	4,245 ± 4,604	.75	Vitamin A carotenoids, approximately 1,500-2,000 μg

*Comments were generated by the software program during the FFQ analysis by computer.

†P value < .05

‡The data on vitamin A, beta-carotene, folic acid and B₆ have been adjusted for Nephrovite contents.

(2,052 ± 2,234 μg/d v 4,524 ± 3,979 μg/d, $P = .004$), denoting that MHD patients had significantly lower intakes of vitamin C and the 2 previously mentioned carotenoid compounds when compared with nondialytic individuals. However, the computerized analysis of Nephrovite components in those who were taking this multivitamin was based on Centrum's components; hence, the results pertaining vitamin A, beta carotene, B₆, and folic acid had to be adjusted in those individuals who mentioned the regular intake of this multivitamin. This led to significant difference in vitamin B₆ (pyridoxine)

intake among MHD patients, which increased from 1.35 ± 0.82 mg (original computerized data, not mentioned in Table 1) to 3.95 ± 0.87 mg (adjusted for Nephrovite intake). The latter number was significantly higher than vitamin B₆ intake among nondialytic individuals (1.73 ± 0.94 mg, $P = .001$). No statistically significant differences were noticed for vitamin A, beta carotene, and folic acid after adjustment for Nephrovite components.

By using the conditional logistic regression analysis for the matched data, the ORs for lower than predetermined cutoff levels in patients re-

Table 5. Odds Ratios for Selected Nutritional Intake Variables in Maintenance Hemodialysis Patients Compared with Nondialytic Control Subjects (Matched for Sex, Age, and Race) After Dichotomizing Based on Predetermined Cutoff Levels

Nutritional Components	Dichotomizing Cutoff	Cases (% < Cutoff)	Controls (% < Cutoff)	Conditional Logistic Regression		
				OR	95% CI	P
Potassium	1,900 mg	70%	37%	3.50	1.15-10.63	.027
Fiber	15 g	47%	20%	2.60	0.93-7.29	.069
Vitamin C	100 mg	63%	30%	4.33	1.23-15.21	.022
Cryptoxanthin	35 μ g	33%	8%	4.50	1.52-13.29	.007
Lycopene	2,500 μ g	67%	23%	7.50	1.72-32.79	.007

ceiving dialysis as compared with nondialytic control subjects were evaluated for potassium, dietary fiber, vitamin C, cryptoxanthin, and lycopene. Table 5 lists the dichotomizing cutoff points and the calculated ORs. Seventy percent of the MHD patients consumed less than 1.9 g of potassium per day, whereas among the nondialytic controls, this proportion was only 37%. The OR of consuming less than 1.9 g/d of potassium in MHD patients as compared with control subjects was 3.50 (95% CI, 1.15 to 10.63; $P = .027$). Although 47% of the MHD patients consumed less than 15 g of dietary fiber per day, as compared with only 20% of nondialytic controls, no statistically significant cutoff level was obtainable for daily dietary fiber intake. In terms of daily vitamin C intake, 63% of the MHD patients ingested less than 100 mg/d of this vitamin, as compared with only 30% of controls, and the OR was 4.33 (95% CI, 1.23 to 15.21; $P = .022$). Similar results were found for the 2 carotenoids in question (ie, cryptoxanthin and lycopene), and the OR values of deficient intake were 4.59 and 7.50, respectively, with significant P values and 95% CIs (Table 5).

Discussion

In this study, we showed that, based on the data obtained by the FFQ, patients on dialysis may take significantly lower amounts of potassium, dietary fiber, vitamin C, and some carotenoids. Patients on dialysis appear to have a lower intake of most nutrients, including minerals and vitamins, but a higher intake of cholesterol. Hence, based on the results of this study, one might hypothesize that the patients receiving dialysis may consume an atherogenic diet. Nevertheless, it should be noted that this hypothesis has not been verified in this study. Moreover, the FFQ may be a practical and user-friendly tool to

compare the information on food-intake among maintenance dialysis patients and nondialysis population and, for epidemiologic studies, to assess the nutrition-related risk of diverse disease conditions in MHD patients when they are compared with individuals without ESRD. It may also be useful to compare higher and lower food intake quantiles among dialysis patients themselves, although this approach was not performed in this study because of the small sample size.

Protein-energy malnutrition and cardiovascular diseases are 2 of the major causes of morbidity and mortality in patients with ESRD.^{2,3} It has been suggested that the interplay between malnutrition and inflammation, what may be referred to as malnutrition-inflammation complex syndrome,¹¹ may lead to increased levels of atherogenic cytokines and resultant cachexia observed in these patients, which predisposes them to increased rate of cardiovascular and coronary artery diseases.² However, the role of dietary composition and daily food intake in the development of these complications has not been well studied.

FFQs have become the major tool in studies pertaining nutritional epidemiology, and they are easy to administer and are inexpensive to process.^{6,12} They have been used in major epidemiologic studies examining the relationship between diet and disease such as in the Nurses' Health Study,¹³ in observational studies to compare dietary intake between groups,^{14,15} and in interventional studies to assess the composition of total diet and dietary change.^{16,17} In a recently published report of the Food and Nutrition Board of the Institute of Medicine,¹⁸ it was acknowledged that, because of the ease of administration and entry of consumption data, FFQs are widely used in epidemiologic studies and that these types of questionnaires may be appropriate in epidemiologic studies for ranking food intake,

to compare intake among different groups, or to estimate food intake—associated relative risk for disease conditions. However, the Food and Nutrition Board added that FFQ data were seldom accurate enough to use to assess the adequacy of dietary intakes of either individuals or small groups because of several limiting characteristics of FFQ. The 3 main reasons for such shortcomings were listed as (1) lack of direct quantitative assessment of individual amounts of nutrients consumed; thus, precise quantification of intake is not feasible, and the calculated intake of nutrients may underestimate the total intake of that nutrient; (2) inadequate coverage of FFQ items to include all available food items; and (3) inclusion of diverse varieties of a given food under one single food item question, and hence, failure to capture significant differences among different subtypes. However, the same report has also underscored potential limitations of other conventional food intake assessment technologies, such as a 3-day food record, because in all likelihood, an individual's observed intake during one 3-day period would differ from observed intake in another 3-day period, and both 3-day observed intakes would differ from true usual intake.¹⁸

Two widely used FFQs are the Willett (also known as Harvard) and the Block (also known as National Cancer Institute) versions.^{12,19} The Block FFQ used in this study assesses both nutrient and food group intake and is designed to evaluate diets of a variety of demographic groups.^{7,8,19} However, a recent report by Subar et al²⁰ showed that a newly developed cognitively based FFQ, the diet history questionnaire, along with Block FFQ are best used for estimating absolute intakes but that, after energy adjustment, all 3 FFQs (diet history questionnaire, Block, and Willett) perform more similarly for the purpose of assessing diet-disease risk. In this regard, it is noteworthy that the dietary protein intake in the MHD patients and the dietary protein and energy intake in the control subjects in this study were lower than published reports.²¹ Notwithstanding the discrepancy, the statistically significant lower intake of potassium, vitamin C, fibers, and carotenoids suggest that these intakes are indeed lower in MHD patients than in healthy control patients. The similarity in the energy and protein intakes of the MHD patients and control subjects provides further support for the likelihood that

the previously noted differences between the 2 groups are real.

To our knowledge, there have been very few studies on dialysis patients in which an FFQ was used as an assessment tool. Reid et al²² developed an FFQ to evaluate folate and zinc intake in 21 MHD patients. Facchini et al²³ used Block's FFQ in 85 patients on maintenance dialysis and in 50 healthy controls and concluded that patients with ESRD ingested an atherogenic diet. Although only available in the form of an abstract, Facchini et al²³ showed that, of 6 dietary constituents associated with cardioprotective effects (folate, vitamin E, vitamin A, total carotenoids, beta carotene, and vitamin C), all but vitamin E were significantly lower in the ESRD diet. Moreover, they showed that the patients with ESRD had significantly lower intakes of potassium, calcium, and phosphorus. They concluded that these ESRD patients maintained calorie intake by eating a high fat, high cholesterol diet, with modest to moderate reductions in protein and carbohydrate.²³ These results are essentially consistent with our findings although some differences exist.

Our FFQ-based analysis showed that the MHD patients' intake of potassium, dietary fiber, vitamin C, and at least 2 carotenoids (cryptoxanthin and lycopene) are lower than those in non-dialytic control subjects. Similar to the findings reported by Facchini et al,²³ we also found a trend denoting that the MHD patients had a lower intake of other cardioprotective nutrients, but these results were not statistically significant. The differences between these 2 studies may be caused by methodology because we used one-to-one matched controls for each case, whereas Facchini et al did not. Moreover, we used the latest (1998) version of the Block's FFQ, whereas Facchini et al used an older version. Nevertheless, the striking resemblance and similar trends found by both studies, despite different study settings and patient populations, underscores the significance of these findings. However, it should be noted again that the analysis of Nephrovite components, which was initially based on Centrum's components, had to be adjusted separately. We are currently involved in designing newer FFQ versions that are based on dietary and supplement intake of patients on dialysis. These FFQs will be based on more accurate information concerning the specific types of multivitamin and elements that are specifically used by dialysis individuals.

Such FFQs should circumvent the previously mentioned shortcomings. Moreover, the analysis of the food components in the Block FFQ is based on the United States Department of Agriculture database, which may be slightly different than other food databases such as that of the Food and Nutrition Board. Nevertheless, such differences are subtle and the same criticism may be raised for the use of any food database.

Both our study and the one by Facchini et al found a low potassium intake among dialysis patients. This finding may lead to the generation of a new hypotheses that prescribed restrictions in potassium in MHD patients may lead to a reduced fruit and vegetable ingestion and reduced dietary fiber intake. Such dietary composition leaves meat and fats as the main source of calories, exposing the patients with ESRD to a more atherogenic diet. Moreover, a low vitamin C intake among patients on dialysis was found by both studies, despite the fact that 11 MHD patients were taking Nephrovite regularly, which contains 60 mg of vitamin C. Block et al²⁴ showed that vitamin C may be an important component of the effectiveness of fruits and vegetables in the reduction in blood pressure and in decreasing the risk of cardiovascular diseases among the nondialytic population. Clermont et al²⁵ showed a decreased vitamin C level among patients with ESRD and concluded that this might provide an explanation for the cardiovascular complications in these patients. Nevertheless, such hypotheses, no matter how attractive and inclusive, need to be tested in prospective studies. Until then, all that can be said is that the deficient fruit and vegetable hypothesis because of potassium restriction may be able to explain the increased cardiovascular risk in dialysis-dependent individuals pending future studies. Moreover, the findings of our study pertaining to vitamin C may suggest that multivitamin supplements are underused in MHD patients, which may be because of Medicaid reimbursement restrictions for prescribed outpatient medications. If many more than only one third of MHD patients in our study were on Nephrovite, the deficiency in vitamin C intake in MHD group might not have happened.

In our study, the MHD patients were found to ingest fewer amounts of cryptoxanthin and lycopene, 2 carotenoids with cardioprotective and anticancer effects. Chronic diseases, such as can-

cer and cardiovascular diseases, are the major causes of deaths in North America, and dietary intake of fruits and vegetables has been suggested to have protective effects against such chronic diseases.^{26,27} Abnormal oxidative stress and impaired antioxidant defense may contribute to accelerated atherogenesis associated with uremia.²⁸ Carotenoids are important plant pigments, which are thought to contribute toward the beneficial effects of fruit and vegetable consumption.²⁷ Rissanen et al²⁹ showed that low plasma lycopene concentration is associated with increased intima-media thickness of the carotid artery wall in the nondialytic population. Ha et al³⁰ showed that plasma lycopene was significantly lower in patients with renal failure. Lim et al²⁷ found that elevated serum ferritin levels, known to be a marker of morbidity and mortality in patients with ESRD,¹¹ may affect the levels of these lipophilic antioxidants, such as plasma lycopene.

Our study is limited by the small sample size and use of historic records for the control group. Moreover, the case subjects and control subjects were not matched for multimorbid conditions. However, exactly the same FFQ analysis was used for the control subjects. Moreover, the matching methodology has strengthened the statistical selectivity of the study and the reliability of the positive results, whereas the negative results cannot prove the null hypothesis because of its limited statistical power. Furthermore, no gold standard was used to evaluate the validity of the FFQ among MHD patients. Nevertheless, the results of the study and the explored trends can be used as new hypotheses for additional studies with larger sample sizes in patients with ESRD based on FFQ and other dietary assessments. Furthermore, in this study, no validation methodology for FFQ was performed. Such an aim can be achieved by performing several 24-hour diet recalls or 3-day food records and comparing the results with that of FFQ analysis. Future studies are needed to evaluate the validation of such unmodified FFQ in patients on dialysis. Moreover, the Block or Willett FFQ has never been validated in patients on dialysis, who differ in their food intakes from dialysis to nondialysis days, who may take many more and different supplements (eg, renal vitamins, phosphate binders, and so on) than do healthy persons or other types of patients. Hence, modified versions of the

FFQ based on such differences should be developed and validated for dialysis patients.

In summary, our findings are consistent with the possibility that FFQ may be a valuable tool to compare food intake among dialysis and nondialysis individuals. Based on the result of our study, we can now further hypothesize that most patients with ESRD are exposed to traditional restrictions in potassium intake, which may result in reduced fruit and vegetable intake, leaving meat and fats as the main source of calories. Because this diet may contribute to atherosclerotic disease and mortality in these patients, maximizing fruit and vegetable intake within acceptable potassium limits and optimizing the intake of antioxidant vitamins may be beneficial in reducing the risk of cardiovascular disease. However, food intake of healthy individuals differs from those who are ill in many of the nutrients they consume and in terms of their quality and quantity. Hence, an FFQ specifically designed for patients on dialysis is needed and will require validation first in prospective studies before its wide-range use. Whether the dialysis patients' diets are truly more atherogenic was not the purpose of this study and is not well documented here. More studies are required to evaluate the value of FFQ and the role of atherogenic diet in patients on dialysis. Several authors of this report are currently involved in the Nutritional and Inflammatory Evaluation in Dialysis study (NIED study), a National Institute of Diabetes, Digestive and Kidney Diseases-funded 5-year prospective study in a cohort of approximately 400 hemodialysis patients, one of whose main aims is to develop and validate the most optimal FFQ versions for use in studies in patients on dialysis. For more information on the NIED study, visit <http://www.nephrology-rei.edu/NIED.htm>. Until the most optimal FFQ versions are validated, the results of such unmodified FFQs should be regarded with great caution in the dialysis population.

Acknowledgment

The authors thank Mabel Onwuka, Shawn Yung, Kevin Wu, Kristen Loutensock, Norma Medina, and other UC Berkeley students for their assistance in conducting interviews, and Patricia Wakamoto, PhD, from UC Berkeley, School of Public Health, for her administrative assistance during the study. Also special thanks to Mary Sheikholeslami, dialysis unit administrator, and Joanne Beltram, dialysis unit social worker, at Fresenius Medical Care dialysis clinic in Berkeley, CA.

References

1. Agodoa L, Briggs J, Mitch W, et al: Nutrition in ESRD patients: Rationale and plan for an initiative. *J Ren Nutr* 9:116-118, 1999
2. Bergstrom J, Lindholm B: Malnutrition, cardiac disease, and mortality: An integrated point of view. *Am J Kidney Dis* 32:834-841, 1998
3. Kopple JD: Nutritional status as a predictor of morbidity and mortality in maintenance dialysis patients. *ASAIO J* 43:246-250, 1997
4. Sharma M, Rao M, Jacob S, et al: A dietary survey in Indian hemodialysis patients. *J Ren Nutr* 9:21-15, 1999
5. Kopple JD: Dietary protein and energy requirements in ESRD patients. *Am J Kidney Dis* 32:S97-S104, 1998 (suppl 4)
6. Willett WC: Future directions in the development of food-frequency questionnaires. *Am J Clin Nutr* 59:171S-174S, 1994 (suppl)
7. Block G, Woods M, Potosky A, et al: Validation of a self-administered diet history questionnaire using multiple diet records. *J Clin Epidemiol* 43:1327-1335, 1990
8. Block G, Thompson FE, Hartman AM, et al: Comparison of two dietary questionnaires validated against multiple dietary records collected during a 1-year period. *J Am Diet Assoc* 92:686-693, 1992
9. Mares-Perlman JA, Klein BEK, Klein R, et al: A diet history questionnaire ranks nutrient intakes in middle-aged and older men and women similarly to multiple food records. *J Nutr* 123:489-501, 1993
10. Rothman KJ, Greenland S: Cohort studies, in Rothman KJ, Greenland S (eds): *Modern Epidemiology*. Philadelphia, PA, Lippincott-Raven, 1998
11. Kalantar-Zadeh K, Don BR, Rodriguez RA, et al: Serum ferritin is a marker of morbidity and mortality in hemodialysis patients. *Am J Kidney Dis* 37:564-572, 2001
12. Caan BJ, Slattery ML, Potter J, et al: Comparison of the Block and the Willett self-administered semiquantitative food frequency questionnaires with an interviewer-administered dietary history. *Am J Epidemiol* 148:1137-1147, 1998
13. Liu S, Manson JE, Stampfer MJ, et al: Whole grain consumption and risk of ischemic stroke in women: A prospective study. *JAMA* 284:1534-1540, 2000
14. Kristal AR, Shattuck AL, Patterson RE: Differences in fat-related dietary patterns between black, Hispanic and White women: Results from the Women's Health Trial Feasibility Study in Minority Populations. *Public Health Nutr* 2:253-262, 1999
15. Hu FB, Rimm EB, Stampfer MJ, et al: Prospective study of major dietary patterns and risk of coronary heart disease in men. *Am J Clin Nutr* 72:912-921, 2000
16. Pijls LT, de Vries H, van Eijk JT, et al: Adherence to protein restriction in patients with type 2 diabetes mellitus: A randomized trial. *Eur J Clin Nutr* 54:347-352, 2000
17. Kristal AR, Feng Z, Coates RJ, et al: Associations of race/ethnicity, education, and dietary intervention with the validity and reliability of a food frequency questionnaire: The Women's Health Trial Feasibility Study in Minority Populations. *Am J Epidemiol* 146:856-869, 1997
18. Institute of Medicine: Minimizing potential errors in assessing group and individual, in Food and Nutrition Board Dietary Reference Intakes: Applications in Dietary Assessment. Washington, DC, National Academy, 2001, pp 147-161

19. Block G: Invited commentary: Comparison of the Block and the Willett food frequency questionnaires. *Am J Epidemiol* 148:1160-1161, 1998
20. Subar AF, Thompson FE, Kipnis V, et al: Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires: The eating at America's Table Study (EATS). *Am J Epidemiol* 154:1089-1099, 2001
21. Mehrotra R, Kopple JD: Nutritional management of maintenance dialysis patients: Why aren't we doing better? *Ann Rev Nutr* 21:343-379, 2001
22. Reid DJ, Barr SI, Leichter J: Effects of folate and zinc supplementation on patients undergoing chronic hemodialysis. *J Am Diet Assoc* 92:574-579, 1992
23. Facchini F, Schoenfeld PY, Dixon B, et al: ESRD patients consume an atherogenic diet. *J Am Soc Neph* 7:S133, 1997 (abstr A1079, suppl 1)
24. Block G, Mangels AR, Norkus EP, et al: Ascorbic acid status and subsequent diastolic and systolic blood pressure. *Hypertension* 37:261-267, 2001
25. Clermont G, Lecour S, Lahet J, et al: Alteration in plasma antioxidant capacities in chronic renal failure and hemodialysis patients: A possible explanation for the increased cardiovascular risk in these patients. *Cardiovasc Res* 47:618-623, 2000
26. Weisburger JH: Approaches for chronic disease prevention based on current understanding of underlying mechanisms. *Am J Clin Nutr* 71:1710S-1714S, 2000 (suppl 6)
27. Agarwal S, Rao AV: Carotenoids and chronic diseases. *Drug Metab Drug Interact* 17:189-210, 2000
28. Lim PS, Chan EC, Lu TC, et al: Lipophilic antioxidants and iron status in ESRD patients on hemodialysis. *Nephron* 86:428-435, 2000
29. Rissanen T, Voutilainen S, Nyyssonen K, et al: Low plasma lycopene concentration is associated with increased intima-media thickness of the carotid artery wall. *Arterioscler Thromb Vasc Biol* 20:2677-2681, 2000
30. Ha TK, Sattar N, Talwar D, et al: Abnormal antioxidant vitamin and carotenoid status in chronic renal failure. *QJM* 89:765-769, 1996

Appendix

Sample of Computerized Analysis of the FFQ Results

Respondent ID: 123456789

The following nutrient values are estimates based on reported frequency of consumption and portion sizes on the diet questionnaire. Nutrients from vitamin supplements are reported separately.

NOTE: The values listed below are unusually low and may indicate inaccurate reporting rather than actual nutrient levels.

Average Daily Nutrients		Recommended Ranges
Total calories	650.9 cal	Depends on age, sex, activity
Calories excluding alcoholic beverages	650.9 cal	Depends on age, sex, activity
Protein	26.5 g	0.36 grams per lb body wt
Total fat	12.2 g	Less than $.034 \times \text{nonalcohol cals}$
Carbohydrate	111.9 g	$0.125 - 0.150 \times \text{nonalcohol cals}$
Calcium	131.3 mg	Teens: 1300 mg, 19-50:1,000, 51+:1,200
Phosphorus	346.5 mg	Teens: 1300 mg, 19-50:1,000, 51+:1,200
Iron	4.5 mg	Men: 10 mg; women: 15 mg
Sodium	768.8 mg	500-2,400 mg
Potassium	967.3 mg	2000-3,500 mg or more
Vitamin A (IU)	16,058.8 IU	Men: 5,000 IU; women: 4,000 IU
Vitamin A (RE)	1,640.5 RE	Men: 1,000; women: 800
Thiamin (B ₁)	0.4 mg	Men: 1.2 mg; women: 1.1 mg
Riboflavin (B ₂)	0.3 mg	Men: 1.3 mg; women: 1.1 mg
Niacin	9.7 mg	Men: 16 mg; women: 14 mg
Vitamin C	45.9 mg	100 mg or more, especially for smokers
Saturated fat	3.2 g	Approximately 1/3 of fat
Oleic acid	4.9 g	Approximately 1/3 of fat
Linoleic acid	2.8 g	Approximately 1/3 of fat
Cholesterol	56.9 mg	Less than 300 mg
Dietary fiber	10.8 g	20-35 grams
Folate	124.6 μg	400/day; if pregnant, 600
Vitamin E	3.1 a-TE	Men: 10; women: 8 mg a-TE
Zinc	2.7 mg	Men: 15 mg; women: 12 mg
Zinc from animal	1.1 mg	No recommendation.
Vitamin B ₆	0.8 mg	Adults:1.3 mg, age 51+: M:1.7 F:1.5
Magnesium	85.9 mg	Men: 350 mg; women: 280 mg
Alpha-carotene	2,602.7 μg	A carotenoid, no range set
Beta-carotene	60,12.2 μg	A carotenoid, no range set
Cryptoxanthine	0.0 μg	A carotenoid, no range set
Lutein	1,417.5 μg	A carotenoid, no range set
Lycopene	56.6 μg	A carotenoid, no range set
Retinol	30.1 μg	Preformed vitamin A, approx. 500-800
Pro-A carotenes	9,530.6 μg	Vitamin A carotenoids, approx. 1,500-2,000
Genistein	0.0 μg	A phytoestrogen, no range set
Daidzein	0.0 μg	A phytoestrogen, no range set
Vitamin D	14.3 IU	400 IU

Respondent ID: 123456789

% Calories Excluding Alcoholic Beverages		Recommended Ranges
From Fat:	16.9%	Less than 30%
From Protein:	16.3%	10%-12% (more if over age 60)
From Carbohydrate:	68.8%	50%-60%

Percent of Total Calories	
From Fat:	16.9%
From Protein:	16.3%
From Carbohydrate:	68.8%
From Sweets:	22.7%
From Alcohol:	0.0%

Grouped Foods	Frequency (per day)	Recommended Servings
Fruit and fruit juice	1.1	2-4 servings
Fats, oils, sweets, & snacks	1.0	Use sparingly
Vegetables excluding potatoes	3.7	3-5 servings
Breads, cereals, rice, pasta	2.1	6-11 servings
Sweets	1.0	Use sparingly
Alcoholic beverages	0.0	In moderation

Your reported weight is 143 pounds.

The desirable weight for your height is approximately 135-149 pounds.

Average Daily Intake of Vitamins from Supplements:

Vitamin A:	5,000.0 IU
Vitamin C:	60.0 mg
Vitamin D:	400.0 IU
Vitamin E:	20.1 a-TE
Iron:	18.0 mg
Calcium:	130.0 mg
Zinc:	15.0 mg
B-Carotene:	1,200.0 µg*
Thiamin:	1.5 mg
B ₆ :	2.0 mg
B ₁₂ :	6.0 µg
Folate:	400.0 µg
Copper:	2.0 mg
Selenium:	20.0 mg
Riboflavin:	1.7 mg
Magnesium:	100.0 mg
Niacin:	20.0 mg

Other Vitamin: None Stated

* - Not all brands of multiple vitamins contain beta-carotene.

Respondent ID: 123456789

Top Sources

Total calories		
Soft drinks or Snapple (not diet)	147.60 cal	
(Snapple Beverage Corp, White Plains, NY)		
Rice or dishes with rice	113.75 cal	
Apples or pears	81.42 cal	
Total fat		
Fried chicken (w/o skin)	2.02 g	
Vegetable stew	1.87 g	
Chinese dishes	1.79 g	
Saturated fat		
Fried chicken (w/o skin)	0.55 g	
French fries, fried potatoes	0.47 g	
Chinese dishes	0.43 g	
Dietary fiber		
Apples or pears	3.73 g	
Vegetable stew	1.42 g	
Broccoli	1.38 g	
Vitamin C		
Broccoli	18.45 mg	
Green salad	9.19 mg	
Apples or pears	7.87 mg	
Pro-A carotenes		
Carrots	5,745.64 μ g	
Vegetable stew	2,522.37 μ g	
Broccoli	522.19 μ g	
Zinc		
Fried chicken (w/o skin)	0.46 mg	
Rice or dishes with rice	0.43 mg	
Hamburger, cheeseburger	0.27 mg	
Folate		
Rice or dishes with rice	50.75 μ g	
Green salad	14.66 μ g	
Broccoli	13.80 μ g	
Cholesterol		
Fried chicken (w/o skin)	32.76 mg	
Shellfish (shrimp, crab, etc.)	9.60 mg	
Chinese dishes	5.48 mg	
Sodium		
Vegetable stew	193.69 mg	
Rice or dishes with rice	131.25 mg	
Vegetable soup	112.94 mg	