What do vegetarians in the United States eat?[1–4]

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ABSTRACT

Background: Dietary patterns and nutrient intakes of vegetarians in a nationally representative survey have not been described.

Objective: We sought to profile and compare nutrient and food consumption patterns of self-defined vegetarians and nonvegetarians in a representative sample of the US population.

Design: Data from 13 313 participants (age: ≥ 6 y) in the Continuing Survey of Food Intake by Individuals (CSFII) 1994–1996, 1998 were used to compare vegetarian and nonvegetarian dietary patterns. Self-defined vegetarians and nonvegetarians were those who responded positively or negatively, respectively, to the question "Do you consider yourself to be a vegetarian?" The vegetarian and nonvegetarian groups were further characterized as "no meat" or "ate meat" on the basis of a consumption cutoff of 10 g meat/d reported on 2 nonconsecutive 24-h dietary recalls.

Results: Self-defined vegetarians whose recalls did not include meat represented 0.9% of this nationally representative sample of noninstitutionalized persons residing in the United States. Compared with nonvegetarians who ate meat, self-defined vegetarians aged ≥ 20 y had lower body mass indexes regardless of whether they ate meat. Diets of self-defined vegetarians tended to be lower in total fat, saturated fat, and cholesterol and higher in fiber than did the diets of nonvegetarians who ate meat. Self-defined vegetarians whose recalls contained no meat consumed more grains, legumes, vegetables (green leafy and yellow), fruit, and wine, whereas those who ate meat consumed more fruit than did nonvegetarians.

Conclusion: Self-defined vegetarians may consume red meat, poultry, or fish. However, their dietary patterns are generally healthier than are those of nonvegetarians. *Am J Clin Nutr* 2003;78(suppl):626S–32S.

KEY WORDS Vegetarians, vegetarian diets, dietary patterns, Continuing Survey of Food Intake by Individuals, CSFII

INTRODUCTION

Although there is no universally accepted definition for the term *vegetarian* (1, 2), the term is nonetheless used to describe a dietary pattern characterized by an emphasis on plant foods and the avoidance of flesh foods (ie, meat, poultry, and fish). Vegetarians who avoid all animal products are referred to as *vegans*. During the past 2 decades, studies have documented eating patterns and nutrient intakes of vegetarians in the United States (3–7). The studies, however, were conducted in volunteers and convenience samples recruited from relatively narrow geographic areas or from individuals belonging to a particular vegetarian orientation. Little is known about the eating patterns of a nationally representative sample of individuals who consider themselves to be vegetarians.

The Continuing Survey of Food Intake by Individuals (CSFII), conducted by the US Department of Agriculture, collects food consumption information on a representative sample of noninstitutionalized persons residing in the United States. Recently, Kennedy et al (8) used the CSFII data to compare Healthy Eating Index (HEI) variables in prototype vegetarian and nonvegetarian diets. They defined the vegetarian diet as no meat, poultry, or fish reported on a single 24-h recall obtained from adults, aged 19 and older, on day 1 of the survey. However, one item in the CSFII asks respondents to identify themselves as vegetarian or nonvegetarian. An interesting question is what this group of self-defined vegetarians, who are a statistically representative sample of US vegetarians, actually consume. What are the dietary patterns and nutrient distribution of diets reported by self-defined vegetarians? The purpose of this study was to compare nutrient intakes and food patterns of self-defined vegetarians in the CSFII database with those of the general nonvegetarian population.

SUBJECTS AND METHODS

Study population and dietary intake data

Data for the current study were drawn from the CSFII, conducted by the US Department of Agriculture as part of the ongoing national nutrition monitoring system (9). The CSFII collects food consumption and dietary pattern information on a representative sample of noninstitutionalized persons residing in the United States. The CSFII data were collected from 16 103 individuals of all ages over a 3-y period (1994–1996), plus an additional 5559 children, aged 0–9 y, in 1998.

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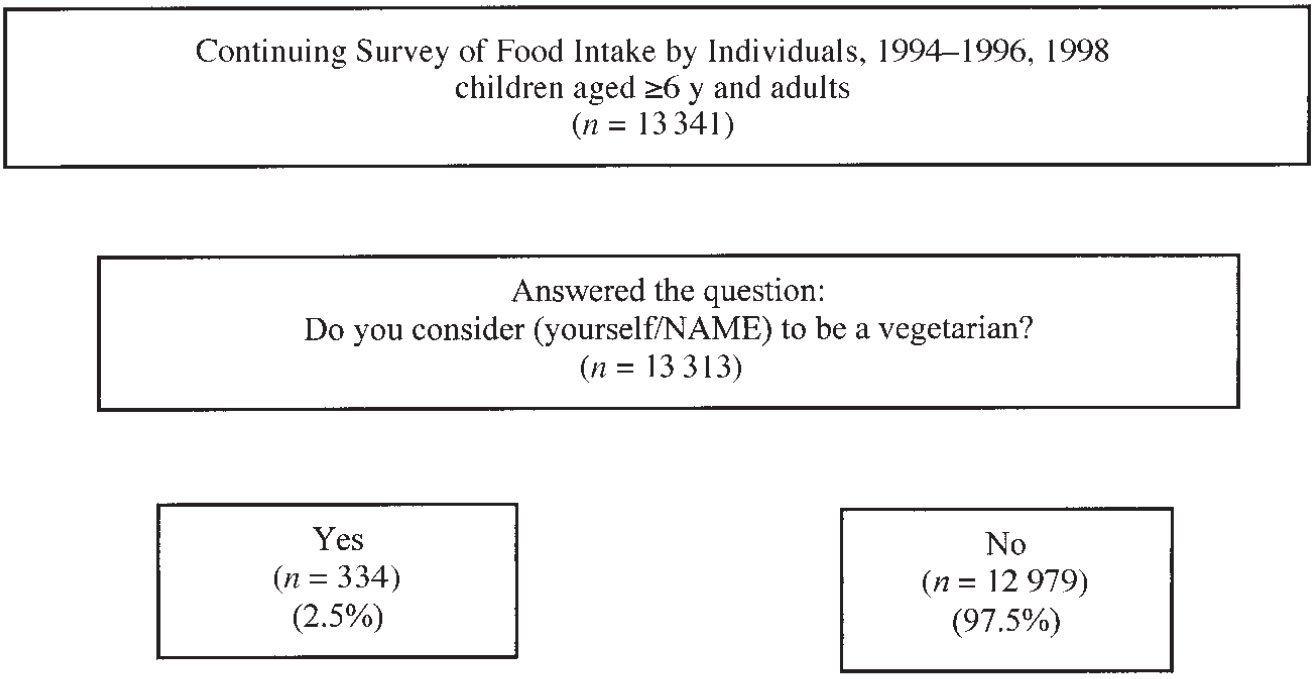

FIGURE 1. Schematic diagram for classifying self-defined vegetarian and nonvegetarian status in participants in the Continuing Survey of Food Intake by Individuals 1994–1996, 1998 aged ≥ 6 y.

The dietary intake data from the survey were collected on 2 nonconsecutive days, 3–10 d apart, through an interviewer-administered 24-h recall using a multiple-pass interviewing strategy. Proxy interviews were conducted for children < 6 y of age and for older subjects not able to report intakes themselves. Children aged 6–11 y provided their own intakes, assisted by an adult household member. Only data on children aged 6 and older and adults were included in the analyses for this paper.

Vegetarian status

The CSFII included the question, "Do you consider (Yourself/NAME) to be a vegetarian?" Of the 13 313 respondents, 334 of those aged 6 and older answered "yes." Vegetarian and nonvegetarian status in this study is therefore self-defined. A careful examination of the reported dietary intakes of vegetarians who responded positively to the above question showed consumption of meat, poultry, or fish by less than two-thirds of the group. Because the dietary intake patterns of self-defined vegetarians who report eating meat may differ from those of self-defined vegetarians who do not report eating meat, the group was further categorized as "no meat" or "ate meat" on the basis of a consumption of < 10 g/d or ≥ 10 g/d, respectively, of meat, poultry, and seafood averaged over the two 24-h recall days. The 10-g cutoff level was selected because it represents negligible consumption. Based on the observation that ≈3% of nonvegetarians who responded negatively to the vegetarian question reported < 10 g meat, poultry, or fish intake on the survey days, the "nonvegetarian" group was further categorized as "no meat" or "ate meat" using the 10 g/d cutoff. Because of the limited sample size, it was not possible to assess dietary patterns of vegans—individuals who reported no animal products in their recalls.

Data analysis

Sampling weights provided with the data set were applied to the data to compensate for imbalances in the sampling design and for differential nonresponse rates. Statistical analysis of the weighted data were conducted using release 8.0 of the Statistical Analysis System (10). In the main analysis, tests for significant differences among diet groups were conducted using one-way analysis of variance. *P* values for analyses—planned comparisons of self-defined vegetarians who ate no meat, self-defined vegetarians who ate meat, and self-defined nonvegetarians who ate no meat with self-defined nonvegetarians who ate meat—were adjusted using Dunnett's multiple comparison procedure. Results are reported as weighted least-squares means ± SEs. All results were considered significant when their adjusted *P* value was < 0.05. Percentages of subjects in each diet group who reported intake of selected foods were compared by using logistic regression with β values adjusted by the Bonferroni method.

RESULTS

Participants in the study were classified in diet categories according to the schematic diagram shown in **Figure 1**. There were 334 individuals 6 y of age and older who identified themselves as vegetarians. Of these, 120 reported no meat, and 214 reported some meat (≥ 10 g meat, fish, or poultry) on either or both recall days.

TABLE 1
Number of participants in the Continuing Survey of Food Intake (1994–1996, 1998) (CSFII) and the numbers and percentages of self-defined vegetarians in selected age categories[1]

Age category	CSFII participants	Self-defined nonvegetarian		Self-defined vegetarian	
		Ate meat[1]	No meat	Ate meat[1]	No meat
	n	*n* (%)		*n* (%)	
6–11 y	1991	1880 (94.4)	79 (3.97)	19 (0.95)	13 (0.65)
12–19 y	1468	1361 (92.7)	69 (4.70)	19 (1.29)	19 (1.29)
20–29 y	1496	1408 (94.1)	48 (3.21)	17 (1.14)	23 (1.54)
30–39 y	1704	1622 (95.2)	39 (2.29)	25 (1.47)	18 (1.06)
40–49 y	1760	1667 (94.7)	55 (3.13)	18 (1.02)	20 (1.14)
50–59 y	1750	1655 (94.6)	49 (2.80)	35 (2.00)	11 (0.63)
60–69 y	1632	1548 (94.6)	39 (2.39)	37 (2.27)	8 (0.49)
≥70 y	1512	1402 (92.7)	58 (3.84)	44 (2.91)	8 (0.53)
Total	13313	12543 (94.2)	436 (3.27)	214 (1.61)	120 (0.90)

[1] Intake of meat, poultry, or fish of ≥10 g/d on dietary recall days.

The numbers and percentages of self-defined vegetarians by age category are shown in **Table 1**. The percentage of self-defined vegetarians who reported no meat consumption was highest in the 20–29 y age group and lowest in the 60–69 y age group, followed by those aged ≥70 y.

Data on body mass index (BMI) and on energy, macronutrient, fiber, and cholesterol intakes from the recalls obtained from nonvegetarians who did not eat meat, from the self-defined vegetarians who ate meat, and from the self-defined vegetarians who did not eat meat compared with nonvegetarians are presented in **Table 2**. Adult self-defined vegetarians in the ≥20 y age group showed a significantly lower BMI and energy intake than nonvegetarians. In the 12–19 y age group, the energy intake of self-defined vegetarians who reported no meat was significantly lower than that of vegetarians who ate meat. Self-defined nonvegetarians who reported no meat on recall days showed significantly lower energy intakes in all age categories than nonvegetarians who reported meat consumption.

The absence of meat on recall days resulted in lower protein (percentage of energy) in the diets of both self-defined nonvegetarians and vegetarians. On the other hand, diets of vegetarians and nonvegetarians who consumed no meat on recall days were higher in percent energy as carbohydrate and lower in total fat, saturated fat, and monounsaturated fatty acid. Total polyunsaturated fatty acid (PUFA) was lower in the groups that excluded meat and higher in self-defined vegetarians who reported meat. Both n−6 PUFA and n−3 PUFA were lower in nonvegetarians who did not eat meat and higher in self-defined vegetarians who did eat meat, poultry, and fish.

To evaluate diet quality, the concentration of selected nutrients per 8.37 MJ (2000 kcal) of diets is presented in **Table 3**. The dietary patterns of vegetarians and nonvegetarians who excluded

TABLE 2
Mean BMI, energy intake, and percentage of energy from protein, carbohydrate, and fat of participants in the Continuing Survey of Food Intake (1994–1996, 1998) by self-defined vegetarian status[1]

	Self-defined nonvegetarian		Self-defined vegetarian	
	Ate meat (*n* = 12543)	No meat[2] (*n* = 436)	Ate meat (*n* = 214)	No meat[2] (*n* = 120)
BMI (kg/m^2)				
Ages 6–11 y	18.5 ± 0.1	18.3 ± 0.6	17.8 ± 1.0	17.3 ± 1.5
Ages 12–19 y	22.3 ± 0.1	21.3 ± 0.5	20.8 ± 1.0	20.0 ± 1.0
Ages ≥20 y	26.1 ± 0.1	25.6 ± 0.3	23.9 ± 0.4[3]	22.8 ± 0.5[3]
Energy (MJ/d)				
Ages 6–11 y	8.06 ± 0.05	7.12 ± 0.27[4]	8.36 ± 0.5	7.20 ± 0.74
Ages 12–19 y	9.77 ± 0.11	8.03 ± 0.49[4]	8.69 ± 0.95	7.24 ± 0.97[5]
Ages ≥20 y	8.52 ± 0.04	6.65 ± 0.23[3]	7.24 ± 0.30[3]	7.11 ± 0.38[3]
Protein (% of energy)	15.6 ± 0.0	11.7 ± 0.2[3]	15.3 ± 0.3	11.6 ± 0.3[3]
Carbohydrate (% of energy)	50.1 ± 0.1	58.4 ± 0.4[3]	53.5 ± 0.6[3]	60.0 ± 0.8[3]
Total fat (% of energy)	32.9 ± 0.1	28.2 ± 0.4[3]	30.2 ± 0.5[3]	25.1 ± 0.7[3]
SFA (% of energy)	11.1 ± 0.0	9.9 ± 0.2[3]	9.6 ± 0.2[3]	8.2 ± 0.3[3]
MUFA (% of energy)	12.6 ± 0.0	10.3 ± 0.2[3]	11.2 ± 0.2[3]	9.1 ± 0.3[3]
Total PUFA (% of energy)	6.5 ± 0.0	6.0 ± 0.1[3]	7.0 ± 0.2[5]	5.9 ± 0.2[5]
n−6 PUFA (% of energy)	5.8 ± 0.0	5.4 ± 0.1[3]	6.3 ± 0.2[5]	5.3 ± 0.2[5]
n−3 PUFA (% of energy)	0.62 ± 0.0	0.55 ± 0.01[3]	0.71 ± 0.02[3]	0.61 ± 0.02
n−6:n−3	10.0 ± 0.0	10.8 ± 0.2[3]	9.4 ± 0.3	9.0 ± 0.3[4]

[1] Weighted least-squares $\bar{x}$ ± SE. MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid.

[2] Intake of meat, poultry or fish of <10 g/d on dietary recall days.

[3–5] Significantly different from self-defined nonvegetarians who reported intakes of <10 g meat, poultry, or fish on dietary recall days (after adjustment for multiple comparisons by using Dunnett's procedure): [3] $P < 0.001$, [4] $P < 0.01$, [5] $P < 0.05$.

TABLE 3
Mean intakes (per 8.37 MJ, or 2000 kcal) of selected nutrients, cholesterol, and dietary fiber from 2 d of dietary recalls by self-defined vegetarian status[1]

	Self-defined nonvegetarian		Self-defined vegetarian	
	Ate meat (n = 12 543)	No meat[2] (n = 436)	Ate meat (n = 214)	No meat[2] (n = 120)
Vitamins				
Vitamin A (RE)	1001 ± 10	1074 ± 52	1174 ± 75	1696 ± 93[3]
Carotene (mg)	497 ± 7	525 ± 36	669 ± 52[3]	1278 ± 64[3]
Vitamin E (mg)	7.88 ± 0.05	8.87 ± 0.25[3]	8.94 ± 0.35[4]	9.71 ± 0.43[3]
Vitamin C (mg)	98 ± 1	138 ± 4[3]	128 ± 6[3]	161 ± 7[3]
Thiamine (mg)	1.60 ± 0.00	1.70 ± 0.03[4]	1.68 ± 0.04	1.75 ± 0.05[4]
Riboflavin (mg)	1.90 ± 0.01	2.07 ± 0.03[3]	1.99 ± 0.05	1.92 ± 0.06
Niacin (mg)	22.9 ± 0.1	19.3 ± 0.4[3]	23.0 ± 0.6	17.2 ± 0.7[3]
Vitamin B-6 (mg)	1.80 ± 0.01	1.71 ± 0.04	1.95 ± 0.05[5]	1.84 ± 0.07
Folate (μg)	258 ± 1	317 ± 7[3]	308 ± 10[3]	391 ± 12[3]
Vitamin B-12 (μg)	5.04 ± 0.07	3.12 ± 0.38[3]	4.39± 0.55	2.40 ± 0.68[3]
Minerals				
Calcium (mg)	771 ± 3	960 ± 28[3]	861 ± 23[3]	964 ± 16[3]
Phosphorus (mg)	1226 ± 3	1200 ± 14	1293 ± 20[4]	1257 ± 25
Magnesium (mg)	267 ± 1	307 ± 5[3]	318 ± 7[3]	346 ± 8[3]
Iron (mg)	15.3 ± 0.1	16.9 ± 0.3[3]	16.2 ± 0.5	16.4 ± 0.6
Zinc (mg)	11.3 ± 0.0	9.6 ± 0.3[3]	10.6 ± 0.4	9.5 ± 0.5[3]
Copper (mg)	1.19 ± 0.00	1.32 ± 0.02[3]	1.35 ± 0.03[3]	1.51 ± 0.04[3]
Dietary cholesterol (mg)	267 ± 1.4	180 ± 7.6[3]	238 ± 10.9[5]	126 ± 13.4[3]
Dietary fiber (mg)	15.3 ± 0.1	18.5 ± 0.3[3]	19.5 ± 0.5[3]	26.1 ± 0.6[3]

[1] Weighted least-squares $\bar{x}$ ± SE.
[2] Intake of meat, poultry or fish of < 10 g/d on dietary recall days.
[3–5] Significantly different from self-defined nonvegetarians who reported intakes of < 10 g meat, poultry, or fish on dietary recall days (after adjustment for multiple comparisons by using Dunnett's procedure): [3] $P < 0.001$, [4] $P < 0.01$, [5] $P < 0.05$.

meat contributed more vitamin E, vitamin C, thiamine, folate, calcium, magnesium, copper, and dietary fiber than those of nonvegetarians who ate meat. Niacin, vitamin B-12, and zinc concentrations were significantly lower in diets of those who reported no meat, poultry, or fish on recall days.

Data on intakes (in g/d) of major food groups and selected foods in the 4 diet categories are shown in **Table 4**. Both the vegetarian and nonvegetarian categories that reported no meat on recall days consumed significantly more grains and legumes than did those who reported eating meat and less table fat. However, only self-defined vegetarians who reported eating no meat had significantly higher intakes of cereals and pasta, rice, vegetables, dark green vegetables, deep yellow vegetables, dried fruit, and other fruit. Self-defined vegetarians, whether or not they reported eating meat, had higher intakes of other vegetables, total fruit, and citrus fruit and juices. Vegetarians, whether or not they reported meat, and nonvegetarians who did not report meat had significantly lower intakes of white potatoes and fried potatoes. Nonvegetarians that reported no meat on recall days showed higher intake of yeast breads and rolls and of nuts and seeds.

Self-defined vegetarians who reported meat on recall days consumed significantly less meat, red meat, and poultry but more fish than nonvegetarians who reported meat. Nonvegetarians who reported eating no meat, and self-defined vegetarians who did and did not report meat, showed significantly lower consumption of beverages compared with nonvegetarians who ate meat. On the other hand, self-defined vegetarians who consumed no meat reported significantly higher intake of wine.

The percentage of subjects in each diet category who reported eating selected foods on at least one recall day are shown in **Table 5**. Self-defined vegetarians reported consuming wholewheat bread, brown rice, soy milk, meat substitutes, lentils, garbanzos, and walnuts and pecans more often than nonvegetarians who ate meat. However, only self-defined vegetarians who did not eat meat reported consuming food items such as tofu, hummus, almonds, and flax seeds more often than any of the other groups. Nonvegetarians who did not consume meat on the recall days reported consuming meat substitutes, lentils, and seeds more often than did those who ate meat.

DISCUSSION

The data presented in this paper indicate that the dietary intake patterns of individuals calling themselves vegetarians are diverse and quite distinct from those of the general population. Vegetarians are usually described as those who consume no meat; however, dietary practices of self-defined vegetarians may range from those who eat reduced amounts of red meat but may consume chicken or fish to those who exclude all animal foods and animal-derived ingredients. In this nationally representative sample of the US population, two-thirds of those who identified themselves as vegetarians reported consuming meat, fish, or poultry on either or both of the 2 d of dietary recall collected in the survey. Similar results have been reported in other studies (11–13). Thus, the avoidance of all flesh foods cannot be assumed. Self-defined vegetarians may eat red meat, chicken, or fish. It is interesting to note that in this nationally representative sample, the mean intake of red meat or chicken in self-defined vegetarians was substantially less than that of nonvegetarians, whereas the mean intake of fish was nearly twice as high (Table 4).

It is difficult to establish an exact number of vegetarians in the US population. Those who answered "yes" to the "Are you a vegetarian?" question represent 2.5% of those aged 6 y and older.

TABLE 4
Mean intakes of selected food groups and foods from 2 d of dietary recalls by self-defined vegetarian status[1]

	Self-defined nonvegetarian		Self-defined vegetarian	
	Ate meat (n = 12 543)	No meat[2] (n = 436)	Ate meat (n = 214)	No meat[2] (n = 120)
	g/d		*g/d*	
Total grains	303 ± 2	363 ± 11[3]	294 ± 15	354 ± 18[4]
Yeast breads and rolls	53 ± 0	36 ± 2[3]	52 ± 3	52 ± 4
Cereals and pasta	72 ± 1	74 ± 6	86 ± 8	116 ± 10[3]
Rice	23 ± 1	20 ± 4	23 ± 5	51 ± 6[3]
Total vegetables	197 ± 1	159 ± 8[3]	214 ± 12	250 ± 14[3]
White potatoes	65 ± 1	33 ± 4[3]	52 ± 6	39 ± 7[5]
Fried potatoes	25 ± 0	11 ± 2[3]	16 ± 3[4]	7 ± 4[3]
Dark green vegetables	12 ± 0	8 ± 2	13 ± 3	28 ± 3[3]
Deep yellow vegetables	9 ± 0	7 ± 1	8 ± 2	19 ± 2[3]
Tomato	30 ± 0	33 ± 3	36 ±4	38 ± 5
Lettuce	15 ± 0	16 ± 1	17 ± 2	21 ± 3
Green beans	7 ± 0	4 ± 1[5]	11 ± 2	5 ± 2
Corn, green peas, lima beans	14 ± 0	6 ± 2[3]	13 ± 3	13 ± 3
Other vegetables	46 ± 1	51 ± 4	63 ± 6[4]	87 ± 7[3]
Total fruit	159 ± 2	178 ± 10	200 ± 15[4]	261 ± 18[3]
Citrus fruit and juices	69 ± 1	73 ± 7	95 ± 10[4]	102 ± 12[4]
Dried fruit	0.8 ± 0.1	1.4 ± 0.3	1.9 ± 0.5	4.7 ± 0.6[3]
Other fruit	88 ± 1	102 ± 7	103 ± 10	151 ± 13[3]
Apples	17 ± 0	15 ± 2	20 ± 3	37 ± 4[3]
Bananas	15 ± 0	17 ± 2	22 ± 3[4]	22 ± 4
Melons and berries	16 ± 1	23 ± 4	15 ± 5	17 ± 7
Total milk (calcium equivalents)	297 ± 3	304 ± 15	305 ± 22	274 ± 27
Milk, milk drinks, yogurt	202 ± 2	207 ± 12	213 ± 7	177 ± 21
Cheese	16 ± 0	17 ± 2	18 ± 2	21 ± 3
Total meat	216 ± 1	1 ± 8[3]	160 ± 12[3]	0 ± 14[3]
Red meat	137 ± 1	1 ± 7[3]	80 ± 10[3]	0 ± 12[3]
Poultry	57 ± 1	0 ± 4[3]	42 ± 6[4]	0 ± 8[3]
Fish	22 ± 1	0 ± 3[3]	38 ± 4[3]	0 ± 5[3]
Legumes	21 ± 1	51 ± 4[3]	30 ± 5	94 ± 6[3]
Nuts and seeds	3.5 ± 0.1	6.2 ± 0.7[3]	4.1 ± 1.0	5.5 ± 1.2
Total fats and oils	15 ± 0	12 ± 1	15 ± 1	13 ± 2
Table fats	3.9 ± 0.1	2.7 ± 0.4[5]	3.1 ± 0.5	1.9 ± 0.7[5]
Salad dressings	8.8 ± 0.1	8.7 ± 0.8	10.0 ± 1.1	9.1 ± 1.3
Total sugars and sweets	24.4 ± 0.4	28.5 ± 2.2	20.6 ± 3.2	18.7 ± 3.9
Sugars	3.4 ± 0.1	3.1 ± 0.5	2.7 ± 0.7	2.9 ± 0.9
Candy	6.7 ± 0.2	7.7 ± 1.0	5.5 ± 1.4	4.6 ± 1.7
Total beverages	965 ± 7	806 ± 40[3]	717 ± 58[3]	680 ± 71[3]
Fruit drinks and ades	89 ± 2	119 ± 11[4]	73 ± 15	94 ± 19
Total alcoholic beverages	101 ± 3	75 ± 18	58 ± 26	131 ± 32
Wine	9.8 ± 0.5	7.0 ± 2.5	9.4 ± 3.5	23.0 ± 4.4[5]
Beer and ale	85 ± 3	61 ± 18	47 ± 25	74 ± 31

[1] Weighted least-squares $\bar{x}$ ± SE.
[2] Intake of meat, poultry and fish of < 10 g/d on dietary recall days.
[3–5] Significantly different from self-defined nonvegetarians who reported intakes of < 10 g meat, poultry, or fish on dietary recall days (after adjustment for multiple comparisons by using Dunnett's procedure): [3] $P < 0.001$, [4] $P < 0.05$, [5] $P < 0.01$.

Defining vegetarians as those who never eat meat, poultry, or fish, a recent Zogby poll commissioned by the Vegetarian Resource Group (14) also indicated that 2.5% of the statistical population aged 18 and older can be considered vegetarian. A recent survey of a multiethnic, urban population of adolescents (11–18 y) by Perry et al (15) reported that 6% responded "yes" to the "Are you a vegetarian?" question, compared with 2.6% of youth (12–19 y) who did so in the CSFII. Also, only about one-third of self-defined vegetarians in the CSFII reported no meat, poultry, or fish on recall days. Therefore, the best estimate for the prevalence of vegetarians in the United States may be derived from this nationally representative sample based on the number of self-defined vegetarians aged 6 y and older who reported no meat on recall days, which is 0.9% of the population.

Studies have found that vegetarians on the average are thinner than nonvegetarians (16). Because of the obesity epidemic in the United States, this is a pertinent issue. Energy intakes in dietary recalls that did not include meat tended to be lower than those of nonvegetarians that included meat, for all age categories. BMIs of self-defined vegetarians were also lower than those of nonvegetarians, and this difference was statistically significant in the ≥ 20 y age group, whether or not they reported eating meat.

Recent studies have suggested that vegetarians consume diets consistent with current dietary guidelines (8, 11, 13, 17). Compared

TABLE 5
Percentage of subjects in each diet group who reported intake of selected foods on at least one dietary recall day

	Self-defined nonvegetarian		Self-defined vegetarian	
	Ate meat (n = 12 543)	No meat[1] (n = 436)	Ate meat (n = 214)	No meat[1] (n = 120)
	%		%	
Whole-wheat bread	14.0	13.0	25.6[2]	21.2[2]
Brown rice	1.3	1.0	3.8[2]	5.6[2]
Soy milk	0.2	0.2	1.3[2]	5.9[2]
Tofu	0.5	0.7	0.9	6.1[2]
Soy powder	0.2	0.7	0.2	0.6
Textured vegetable protein	0.0	0.0	0.0	0.8
Meat substitutes	0.3	1.6[3]	2.5[2]	5.8[2]
Meat-substitute dishes	0.1	0.3	0.0	0.8
Lentils	0.4	1.2	2.4[2]	11.8[2]
Garbanzos	0.8	0.9	2.6[2]	8.1[2]
Falafiel	0.1	0.3	0.0	0.0
Hummus	0.3	0.6	0.5	5.6[2]
Almonds	0.4	0.6	0.0	3.4[2]
Walnuts and pecans	0.7	0.1	2.8[2]	4.0[2]
Seeds	1.0	3.1[2]	1.9	0.4
Flax seeds	0.0	0.0	0.0	0.8[3]

[1] Intake of meat, poultry, or fish of <10 g/d on dietary recall days.
[2] Significantly different from self-defined nonvegetarians who reported intakes of <10 g meat, poultry, or fish on dietary recall days, $P < 0.05$ (after Bonferroni's correction for multiple comparisons).

with nonvegetarians who reported meat intake, the recalls of self-defined vegetarians, whether or not those recalls contained meat, and the recalls of nonvegetarians that contained no meat were lower in total and saturated fat and cholesterol and higher in fiber—which reflects a healthier dietary pattern. Our results are similar to those obtained using CSFII 1996 data by Kennedy et al (8), who contrasted fat, saturated fat, and other HEI parameters applied to 24-h recalls that did and did not contain meat. It is interesting to note in this regard that recalls obtained from self-defined vegetarians who reported eating meat were significantly lower in energy, total fat, and saturated fat than those of nonvegetarians who ate meat.

Often identified as being nutrients of concern in vegetarian diets are protein, n−3 fatty acids, calcium, iron, zinc, niacin, and vitamin B-12 (18–20). Although the meatless diets were lower in protein, providing slightly <12% of energy, compared with ≈15–16% of energy in recalls containing meat, that level is considered adequate if energy intake is sufficient. The n−3 intake of vegetarians who reported no meat, poultry, or fish on recall days was not significantly different from that of nonvegetarians in the study sample. In fact, vegetarians who reported meat on recall days had higher dietary levels of n−3 fatty acid as percent energy, which suggests that the meat consumed was possibly fish or seafood. It is interesting to note that the calcium contribution of the diets of self-defined vegetarians, both with and without meat, and of the nonvegetarians who did not report any meat, were higher than those of nonvegetarians. The consumption of milk, dairy foods, and cheese was not significantly different between the groups (Table 4). The dietary recalls of the meatless categories contained more iron but less zinc. The major issue related to iron nutritional status is its bioavailability on meatless diets—an issue that cannot be resolved based on survey data. Recent studies indicate that iron deficiency and iron deficiency anemia are not more common among vegetarians in developed countries compared with the general population (21–24). Many studies have reported lower zinc intakes and lower serum zinc concentrations in vegetarians. Whether zinc nutritional status of vegetarians is compromised is not known because of the lack of a relevant functional indicator of status (24–26). The niacin concentrations were significantly lower in recalls that contained no meat.

As expected (6, 27), the vitamin B-12 content of meatless dietary recalls was lower than that of meat-containing diets but higher than that observed among vegetarians in other countries (28, 29). The nutrient content of the US food supply reflects levels of fortification and enrichment of foods, and B-12 is added to a number of food items commonly consumed by vegetarians, such as soy milk and meat substitutes.

In nutritional research, it is more common to consider food consumption in terms of nutrient intake than in terms of the type of food consumed. Consumers, however, eat *food*, and eat their food in certain combinations or patterns. In this study we attempted to identify food consumption patterns of self-defined vegetarians and to contrast them with the patterns of the general population. What emerged was an interesting picture. Compared with nonvegetarians whose recalls listed meat, self-defined vegetarians who reported no meat tended to consume more grains such as cereals, pasta, and rice; more legumes; and more vegetables, especially dark green and deep yellow vegetables, but not more of commonly eaten vegetables such as tomatoes, lettuce, green beans, green peas, or corn. Vegetarians who avoid meat also ate more fruit, citrus fruit and juice, and dried fruit. However, consumption patterns of vegetarians who reported no meat were not significantly different from those of nonvegetarians in intakes of milk, milk drinks, yogurt, cheese, fats and oils, salad dressings, and sugars and sweets. Self-defined vegetarians whose recalls included meat, poultry, or fish consumed more fruit and some vegetables, and less white potatoes and fried potatoes, than nonvegetarians. Also, self-defined vegetarians who reported no meat on their recalls drank more wine—in fact, the mean intake of wine was more than twice that of any of the other groups. In comparison with nonvegetarians whose recalls listed meat, a higher percentage of self-defined vegetarians reported consuming food items usually associated with vegetarianism such as whole-wheat bread, brown rice, soy milk, tofu, meat substitutes, lentils, garbanzos, and walnuts and pecans.

A most interesting pattern was that of the nonvegetarians, who reported no meat, chicken, or fish on their dietary recalls. Compared with nonvegetarians who ate meat, their pattern was characterized by a higher intake of grains, legumes, and nuts and seeds; and a lower intake of vegetables, white potatoes, and fried potatoes.

The reliance of dietary surveys on self-reported dietary information presents a major limitation of this study and an opportunity for bias in the results. Underreporting of foods consumed is a well-documented bias of self-reported dietary information. This phenomenon is attributable to social desirability bias in food reporting. Self-defined vegetarians may be more apt to report intake of certain food items depending on their perceived "healthfulness" in the diet.

In summary, not all self-defined vegetarians avoid meat. In fact, persons who describe themselves as vegetarian may eat red meat, chicken, or fish. Self-defined vegetarians who did not report meat consumption on their dietary recalls represent ≈0.9% of the US

population aged ≥6 y. Compared with nonvegetarians who reported meat consumption in their dietary recalls, self-defined vegetarians who reported no meat consumption ate more grains, legumes, vegetables, fruit, and wine.

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REFERENCES

1. Weinsier R. Use of the term vegetarian. Am J Clin Nutr 2000;71:1211–3.
2. Johnston PK, Sabaté J. Reply to R Weinsier. Am J Clin Nutr 2000; 71:1212–3.
3. Shultz TD, Leklem JE. Dietary studies of Seventh-day Adventist and non-vegetarians. J Am Diet Assoc 1983;83:27–33.
4. Abdulla M, Aly KO, Andersson I, et al. Nutrient intake and health status of lactovegetarians: chemical analyses of diets using the duplicate portion sampling technique. Am J Clin Nutr 1984;40:325–38.
5. Hunt IF, Murphy NJ, Henderson C. Food and nutrient intake of Seventh-day Adventist women. Am J Clin Nutr 1988;48(suppl):850–1.
6. Haddad EH, Berk LS, Kettering JD, Hubbard RW, Peters WR. Dietary intake and biochemical, hematologic, and immune status of vegans compared with nonvegetarians. Am J Clin Nutr 1999;70(suppl)586S–93S.
7. White RF, Seymour J, Frank E. Vegetarianism among US women physicians. J Am Diet Assoc 1999;99:595–8.
8. Kennedy ET, Bowman SA, Spence JT, Freedman M, King J. Popular diets: correlation to health, nutrition and obesity. J Am Diet Assoc 2001;101:411–20.
9. US Department of Agriculture. Agricultural Research Service. 2000. Continuing Survey of Food Intake by Individuals, 1994–1996, 1998. CD-ROM.
10. SAS Institute. SAS/STAT software: changes ansd enhancements. Release 8.0. Cary, NC: SAS Institute Inc, 2002.
11. Janelle KC, Barr SI. Nutrient intakes and eating behavior scores of vegetarian and nonvegetarian women. J Am Diet Assoc 1995;95: 180–6, 189.
12. White R, Frank E. Health effects and prevalence of vegetarianism. West J Med 1994;160:465–71.
13. Barr SI, Chapman GE. Perceptions and practices of self-defined current vegetarian, former vegetarian, and non-vegetarian women. J Am Diet Assoc 2002;102:354–60.
14. Vegetarian Resource Group. How many vegetarians are there? Internet: http//www.vrg.org/nutshell/poll2000.htm (accessed 6 August 2002).
15. Perry CL, McGuire MT, Neumark-Sztainer D, Story M. Characteristics of vegetarian adolescents in a multiethnic urban population. J Adolesc Health 2001;29:406–16.
16. Appleby PN, Thorogood M, Mann JI, Key TJ. Low body mass index in non-meat eaters: the possible roles of animal fat, dietary fibre and alcohol. Int J Obes Relat Metab Disord 1998;22:454–60.
17. Perry CL, McGuire MT, Neumark-Sztainer D, Story M. Adolescent vegetarians: how well do their dietary patterns meet the Healthy People 2010 objectives? Arch Pediatr Adolesc Med 2002; 156:431–7.
18. Freeland-Graves J. Mineral adequacy of vegetarian diets. Am J Clin Nutr 1988;48(suppl):859–62. 19. Kelsay JL, Frazier CW, Prather ES, Canary JJ, Clark WM, Powell AS. Impact of variation in carbohydrate intake on mineral utilization by vegetarians. Am J Clin Nutr 1988;48(suppl):875–9.
20. Draper A, Lewis J, Malhotra N, Wheeler E. The energy and nutrient intakes of different types of vegetarian: a case for supplements? Br J Nutr 1993;69:3–19.
21. Worthington-Roberts BS, Breskin MW, Monsen ER. Iron status of premenopausal women in a university community and its relationship to habitual dietary sources of protein. Am J Clin Nutr 1988; 47:275–9.
22. Reddy S, Sanders T. Hematological studies on pre-menopausal Indian and Caucasian vegetarians compared with Caucasian omnivores. Br J Nutr 1990;64:331–8.
23. Alexander D, Ball MJ, Mann J. Nutrient intake and hematological status of vegetarians and age-sex matched omnivores. Eur J Clin Nutr 1994;48:538–46.
24. Hunt JR, Roughead ZK. Nonheme-iron absorption, fecal ferritin excretion, and blood indexes of iron status in women consuming controlled lactoovovegetarian diets for 8 wk. Am J Clin Nutr 1999;69: 944–52.
25. Larsson CL, Johansson GK. Dietary intake and nutritional status of young vegans and omnivores in Sweden. Am J Clin Nutr 2002; 76:100–6.
26. Ball MJ, Ackland ML. Zinc intake and status in Australian vegetarians. Br J Nutr 2000;83:27–33.
27. Miller DR, Specker BL, Ho ML, Norman EJ. Vitamin B-12 status in a macrobiotic community. Am J Clin Nutr 1991;53:524–9.
28. Hung CJ, Huang PC, Lu SC, et al. Plasma homocysteine levels in Taiwanese vegetarians are higher than those of omnivores. J Nutr 2002; 132:152–8.
29. Mann NJ, Li D, Sinclair AJ, et al. The effect of diet on plasma homocysteine concentrations in healthy male subjects. Eur J Clin Nutr 1999;53:895–9.