Use of vitamin-mineral supplements by female physicians in the United States[1–3]

Erica Frank, Adrianne Bendich, and Maxine Denniston

ABSTRACT

Background: Rates of vitamin-mineral supplement use by US female physicians are unknown but are of particular interest for several epidemiologic and clinical reasons.

Objective: The objective was to determine rates of and variations in vitamin-mineral supplement use among US female physicians.

Design: We used data from the Women Physicians' Health Study, a large (n = 4501) national, randomly sampled mail survey of female physicians aged 30–70 y.

Results: Half of the physicians took a multivitamin-mineral supplement; 35.5% of these did so regularly. However, ≤33% took any supplement other than calcium and <20% did so regularly. Regular vitamin-mineral supplement use increased with age, and antioxidant intake was higher in those at high risk of heart disease. Those with a history of osteoporosis were nearly 3 times as likely as those with no history to take supplemental calcium regularly. Those who took any supplement regularly also consumed more fruit and vegetables daily than did occasional users or nonusers ($P < 0.0001$). Regular users of any supplement also consumed less fat than did occasional users or nonusers ($P < 0.01$). Additionally, vegetarians were more likely than were nonvegetarians to regularly consume any supplement (59.9% compared with 46.3%; $P < 0.001$) and those who regularly consumed any supplement were more likely to comply with US Preventive Services Task Force guidelines than were those who were occasional users or nonusers (72.4% compared with 66.5% and 60.2%; $P < 0.0001$).

Conclusion: Female physicians, particularly those who were especially health conscious or at higher risk of heart disease or osteoporosis, used supplements at rates at least equal to those of women in the general population. *Am J Clin Nutr* 2000;72:969–75.

KEY WORDS Physicians, women, vitamins, minerals, calcium, iron, vitamin A, vitamin E, ascorbic acid, Women Physicians' Health Study, heart disease

INTRODUCTION

There is substantial and growing interest in reducing chronic disease risk through vitamin and mineral supplementation (1–4). However, not all supplementation trials have shown this to be beneficial (5) and optimal supplement intakes are still highly debated (6–9). Nonetheless, many Americans choose to take supplements containing vitamins and minerals.

Physicians' personal supplement use is of particular interest for many reasons. First, physicians' personal health habits may directly influence their patient counseling habits (10). Second, it is of interest to know the supplement usage behaviors of this particularly well-informed, high-socioeconomic-status cohort; however, unbiased data on these behaviors are limited (**Tables 1** and **2**). In fact, data concerning supplement use by women in health care professions are limited to 2 studies published in the early 1980s. Willett et al (20) reported in 1981 that 38% of ≈2000 nurses aged 30–55 y enrolled in the Nurses' Health Study in 1979 used vitamin supplements. Worthington-Roberts and Breskin (21) in 1984 surveyed >640 female dietitians residing in Washington state; nearly 60% of the dietitians used some type of supplement and 37% did so daily.

We examined data on supplement use, health status, and lifestyle habits from the Women Physicians' Health Study (WPHS), a national mail survey of 4501 US female physicians, and compared these data with national and other cohort studies that examined women's supplement intakes.

METHODS

The design and methods of the WPHS were more fully described elsewhere, as were basic characteristics of the population (27–29). The WPHS surveyed by mail a stratified random sample of US female physicians; the sampling frame was based on the American Medical Association's PHYSICIAN MASTERFILE, a database intended to record all physicians residing in the United States and its possessions. Using a sampling scheme stratified by decade of graduation from medical school,

[1] From the Departments of Family and Preventive Medicine and of Medicine, Emory University School of Medicine, Atlanta; SmithKline Beecham Consumer Healthcare, Parsippany, NJ; and the American Cancer Society, Atlanta.

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[3] Reprints not available. Address correspondence to E Frank, Department of Family and Preventive Medicine, Emory University School of Medicine, 69 Butler Street SE, Atlanta, GA 30303-3219. Efrank@fpm.eushc.org.

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TABLE 1
National surveys of supplemental vitamin and mineral intakes by US women[1]

Reference	Time of survey	Survey name	Survey type	Number of participants	Percentage using supplements regularly
					%
Block et al (11), 1988	1971–1974	NHANES I	In-house	6806 women	26
Koplan et al (12), 1986; Looker et al (13), 1988; Block et al (14), 1994	1976–1980	NHANES II	In-house	4965–6891 women	21
Stewart et al (15), 1985; Bender et al (16), 1992	1980	FDA Vitamin and Mineral Supplement Use Survey	Telephone	2991 men and women	40
Moss et al (17), 1989; Bender et al (16), 1992	1986	NHIS	In-house	6747 women	31
Subar and Block, 1990; Block et al (14), 1994	1987	NHIS	In-house	12 920 women	27
	1988–1991	NHANES III	In-house		
Slesinski et al (19), 1995	1992	NHIS	In-house	12 005 adults; 6885 women	24

[1] NHANES, National Health and Nutrition Examination Survey; NHIS, National Health Interview Survey; FDA, Food and Drug Administration.

we randomly selected 2500 women from each of the graduating classes in the past 4 decades (1950 through 1989). We oversampled older female physicians, a population that would otherwise have been sparsely represented by proportional allocation because of the recent increase in the numbers of female physicians. We included active, part-time, professionally inactive, and retired physicians aged 30–70 y who were not in residency training programs in September 1993, when the sampling frame was constructed. In that month, the first of 4 mailings was sent; each mailing contained a cover letter and a 4-page, self-administered questionnaire. Enrollment was closed in October 1994 (final sample: $n = 4501$).

Of the potential respondents, an estimated 23% were ineligible to participate because their addresses were wrong, they were men, they had died by the time the study began, they were living out of the country, or they were interns. Some 59% of eligible physicians responded to the survey. We compared a large number of key variables between respondents and nonrespondents by using 3 methods: a phone survey (comparison of a phone-surveyed random sample of 200 nonrespondents with all the written-survey respondents), the PHYSICIAN MASTERFILE (comparison between all respondents and all nonrespondents), and an examination of survey mailing waves (from wave 1 through 4 for all respondents). From these 3 investigations we found that nonrespondents were less likely than were respondents to be board-certified. However, other tested measures—including age, ethnicity, marital status, number of children, alcohol consumption, fat intake, exercise, smoking status, hours worked per week, frequency of being a primary care practitioner, personal income, and the percentage of the sample actively practicing medicine—were not consistently or substantively different between respondents and nonrespondents.

On the basis of these findings, we weighted the data by decade of graduation (to adjust for our stratified sampling scheme) and by decade-specific response rates and board-certification status (to adjust for our identified response bias). The analysis weights (within a decade) for board-certified and non-board-certified respondents, respectively, were 3.4 and 5.5 (1950s), 9.3 and 17.7 (1960s), 17.9 and 36.5 (1970s), and 28.3 and 63.9 (1980s). Using these weights allowed us to make inference to the entire population of women physicians graduating from medical school between 1950 and 1989. SUDAAN (Research Triangle Institute, Research Triangle Park, NC) was used for the analyses.

TABLE 2
Surveys of supplemental vitamin and mineral intakes by US women

Reference	Time of survey	Survey name	Survey type	Number of participants	Percentage using supplements regularly
					%
Willett et al (20), 1981	1979	Nurses' Health Study	Mail survey	2000 nurses aged 30–55 y	38
Worthington-Roberts and Breskin (21), 1984	1981	Dietitians in Washington state	Mail survey	640 women and 260 men; 25% either < 30 y or > 50 y and 50% aged 30–50 y	37
Medeiros et al (22), 1990	1986	Seven Western States Supplement Use	Mail survey	934 women and 796 men; average age of 48 y	69% took within the previous week
Merkel et al (23), 1990	1986	Mothers of school-age children in upper midwest	Mail survey	340 women; average age 36 y	52
Patterson et al (24), 1999	1995	Women's Health Initiative	Brought all supplements to in-person clinic interview	16 747 women aged 50–79 y	44
Lyle et al (25), 1999	1996	Beaver Dam Eye Study		2152 white adults aged 43–86 y; 1190 women	32
Patterson et al (26), 1998	1997	Western Washington Survey	Mail survey	325 adults aged 50–74 y	36

TABLE 3
Number of US female physicians who were nonusers, occasional users, and regular users of vitamin-mineral supplements, by supplement type[1]

Supplement	Nonusers (≤1 d/mo)	Occasional users	Regular users (≥5 d/wk)
		%	
Any supplement	35.7 ± 0.9 [1409]	17.0 ± 0.7 [644]	47.3 ± 1.0 [2225]
Multivitamin-mineral	50.2 ± 1.0 [2084]	14.3 ± 0.7 [535]	35.5 ± 0.9 [1566]
Multiantioxidant	83.2 ± 0.7 [3255]	3.8 ± 0.4 [157]	13.0 ± .06 [595]
Vitamin A	84.7 ± 0.7 [3270]	3.9 ± 0.4 [150]	11.5 ± 0.6 [581]
Vitamin C	73.1 ± 0.8 [2807]	8.4 ± 0.5 [311]	18.5 ± 0.7 [930]
Vitamin E	78.2 ± 0.8 [2972]	5.6 ± 0.4 [222]	16.1 ± 0.7 [865]
Calcium	62.2 ± 0.9 [2312]	11.8 ± 0.6 [480]	26.0 ± 0.8 [1294]
Iron	83.2 ± 0.8 [3319]	6.3 ± 0.5 [228]	10.5 ± 0.6 [387]

[1] $\bar{x}$ ± SE; *n* in brackets.

RESULTS

We found that 50% of the female physicians took a multivitamin-mineral supplement and that 35.5% did so regularly (≥5 d/wk; **Table 3**). However, except for calcium, which was the most commonly used single supplement we queried about, only ≤33% of the female physicians ever took any other single supplement, and <20% did so regularly. We also examined differences in usage rates of any supplement on the basis of demographic and lifestyle variables (**Table 4**). We found that regular supplement use increased with age. When the women were stratified by marital status, women who had never married were least likely and widowed women were most likely to use any supplement regularly. More frequent use of any supplement was also associated with lower median household income but not with personal income. We also found that current and former smokers were more likely than were those who had never smoked to regularly use any supplement. Overall, although those who consumed alcoholic beverages were less likely than were nondrinkers to use any supplement regularly, those who reported consuming more than one drink daily were as likely as were nondrinkers to regularly use any supplement. Supplement use was not significantly associated with ethnicity or region of residence in the United States. When use of any supplement was examined by age and ethnicity, those aged ≥55 y tended to be more likely to be regular users than were those aged 30–54 y (**Table 5)**, but this difference was not significantly different between black and Hispanic physicians.

We examined (data not shown) whether those with known coronary heart disease (CHD)—defined as a personal history of myocardial infarction, angina, or bypass (*n* = 49)—had different antioxidant usage rates than did those without CHD. Physicians with CHD were significantly more likely to use a vitamin E supplement regularly ($P < 0.05$). Physicians with CHD who took antioxidants consumed a mean (±SE) of 2.6 ± 0.4 antioxidants (multiantioxidant or vitamins A, C, or E) daily; physicians without CHD consumed an average of 1.1 ± 0.1 antioxidants daily ($P < 0.05$). No other differences in antioxidant consumption between these 2 groups were significant.

The numbers of physicians with CHD risk factors who used antioxidants regularly are shown in **Table 6**, by the specific risk factor: a family history of myocardial infarction, angina, or bypass (*n* = 1503); hypertension (defined as a systolic blood pressure >140 mm Hg or a history of hypertension; *n* = 577); diabetes (*n* = 84); current cigarette smoking (*n* = 176); or a high cholesterol concentration (>6.2 mmol/L, or >240 mg/dL; *n* = 231). We found that for all risk factors except diabetes, female physicians with a CHD risk factor were more likely to take vitamin E supplements regularly than were those without a risk factor. Additionally, for all risk factors except diabetes and high cholesterol, physicians with a CHD risk factor were more likely to take a multiantioxidant regularly than were those without such risk factors. In addition to these differences, we found that female physicians with hypertension were more likely to be regular users of vitamins A and C than were those with normal blood pressure, and current smokers were more likely than were nonsmokers to use vitamin A regularly.

Physicians with a previous diagnosis of breast cancer were more likely to be regular users of all the supplements examined, except for multiantioxidants and iron, than were those without such a diagnosis (**Table 7**). Those with a personal history of osteoporosis were nearly 3 times as likely as those without such a history to take some supplemental calcium regularly. Similarly, those with a family history of osteoporosis were more likely than were those without such a history to take calcium regularly (32.9% compared with 25.0%). Those with a personal history of diabetes or a previous diagnosis of colorectal, skin, cervical, ovarian, or uterine cancer were not significantly more likely to use any of the supplements regularly (although the numbers of such women were generally small) than were those without such a history.

We examined some relevant correlates of supplementary vitamin use (data not shown). Those who took any supplement regularly consumed more ($P < 0.0001$) fruit and vegetables daily (3.4 servings) than did occasional users (2.9 servings) or nonusers (2.8 servings). Regular users of any supplement also consumed less ($P < 0.01$) fat (Block fat score = 20.0) than did occasional users (22.4) or nonusers (21.3). Those who took calcium supplements regularly consumed fewer ($P < 0.001$) dairy products daily (0.71 servings) than did those who were not regular users of calcium supplements (0.85 servings). Additionally, those who regularly consumed any supplement were more likely to personally comply with the US Preventive Services Task Force disease prevention guidelines we examined (29) than were occasional users or nonusers (72.4% compared with 66.5% and 60.2%; $P < 0.0001$). Those who self identified themselves as vegetarians were more likely to be regular users of all the vitamins and supplements that we queried about, except for calcium (**Table 8**). Vegetarians were twice as likely as were nonvegetarians to use single supplements of vitamins A, C, and E and iron (not shown) and had even healthier personal habits than did nonvegetarian physicians (30).

DISCUSSION

This study was the first to document nutritional supplement use by US female physicians. The data were collected in 1993–1994,

TABLE 4
Number of US female physicians who were nonusers, occasional users, and regular users of vitamin-mineral supplements, by demographic and lifestyle variables[1]

Variable	Nonusers (≤1 d/mo)	Occasional users	Regular users (≥5 d/wk)
Age (%)[2]			
All	35.7 ± 0.9 [1409]	17.0 ± 0.7 [644]	47.3 ± 1.0 [2225]
35–44 y	37.7 ± 1.4 [535]	19.5 ± 1.2 [269]	42.8 ± 1.5 [579]
45–54 y	30.6 ± 1.6 [344]	16.9 ± 1.3 [178]	52.6 ± 1.7 [577]
55–64 y	24.4 ± 1.7 [241]	10.9 ± 1.2 [102]	64.8 ± 1.9 [617]
65–70 y	22.5 ± 2.4 [89]	6.7 ± 1.4 [26]	70.8 ± 2.7 [253]
Ethnicity (%)			
Hispanic	42.2 ± 5.0 [28]	11.9 ± 3.0 [20]	45.8 ± 5.0 [78]
Black	40.2 ± 5.1 [48]	17.9 ± 4.3 [20]	41.9 ± 5.1 [57]
Other	42.9 ± 5.7 [39]	11.7 ± 2.9 [19]	45.3 ± 5.7 [58]
Asian	37.3 ± 2.4 [211]	17.4 ± 1.9 [101]	45.3 ± 2.4 [337]
White	34.6 ± 1.1 [1032]	17.2 ± 0.9 [469]	48.3 ± 1.1 [1662]
Marital status (%)			
Unmarried couple	30.9 ± 5.0 [35]	18.7 ± 4.1 [22]	50.5 ± 5.4 [58]
Single, never married	43.9 ± 2.9 [176]	14.9 ± 2.2 [62]	41.2 ± 2.8 [235]
Widowed	26.8 ± 4.8 [35]	15.5 ± 4.6 [14]	57.7 ± 5.7 [78]
Divorced or separated	33.5 ± 3.0 [134]	12.2 ± 2.1 [46]	54.3 ± 3.0 [278]
Married	35.0 ± 1.1 [1001]	17.7 ± 0.9 [479]	47.3 ± 1.1 [1524]
Region (%)			
Northeast	36.6 ± 1.6 [506]	17.3 ± 1.3 [227]	46.1 ± 1.6 [765]
South	32.5 ± 1.9 [288]	18.2 ± 1.6 [148]	49.3 ± 2.1 [474]
Midwest	40.4 ± 2.1 [304]	13.4 ± 1.5 [110]	46.1 ± 2.1 [428]
West	32.8 ± 1.9 [296]	18.7 ± 1.6 [153]	48.4 ± 2.0 [537]
US territory	45.8 ± 9.9 [15]	12.9 ± 5.9 [6]	41.3 ± 9.5 [21]
Median income ($ × 10^3)[3]			
Personal	76 ± 2.4 [1166]	71 ± 2.7 [556]	71 ± 1.4 [1748]
Household[4]	139 ± 3.9 [1177]	131 ± 6.4 [560]	122 ± 2.7 [1768]
Smoking status (%)[5]			
Never	36.9 ± 1.1 [1049]	17.3 ± 0.9 [475]	45.8 ± 1.1 [1527]
Former	30.1 ± 2.0 [247]	17.3 ± 1.7 [135]	52.6 ± 2.2 [510]
Current[6]	35.0 ± 5.0 [55]	12.9 ± 3.8 [17]	52.1 ± 5.2 [104]
Alcohol consumption (%)[6]			
Yes	36.1 ± 1.1 [970]	18.4 ± 0.9 [453]	45.5 ± 1.2 [1459]
No	34.0 ± 1.8 [358]	14.0 ± 1.3 [161]	52.0 ± 1.8 [659]
Frequency of consumption in drinks/wk (%)[6]			
0	34.0 ± 1.8 [358]	14.0 ± 1.3 [161]	52.0 ± 1.8 [659]
≤1	35.1 ± 1.7 [387]	19.5 ± 1.5 [194]	45.4 ± 1.8 [543]
2–4	41.2 ± 2.2 [289]	17.0 ± 1.7 [114]	41.8 ± 2.1 [378]
5–7	32.1 ± 3.6 [89]	23.0 ± 3.4 [52]	44.9 ± 3.8 [156]
8–14	33.8 ± 4.1 [71]	14.0 ± 2.7 [35]	52.1 ± 4.1 [139]
>14	30.9 ± 8.0 [14]	13.5 ± 5.0 [9]	55.6 ± 8.6 [28]

[1] $\bar{x}$ ± SE; *n* in brackets.
[2,5,6] Distribution significantly different (chi-square test): [2] $P \leq 0.0001$, [5] $P \leq 0.05$, [6] $P < 0.01$.
[3] Median values.
[4] Distribution significantly different, $P \leq 0.01$ (split chi-square test).

when many clinical and epidemiologic studies were published suggesting links between supplement use and reduced risk of several major chronic diseases, including cancer, cardiovascular disease, and osteoporosis (14, 31). It appears from our data that more female physicians at risk or with some of these diseases used supplements than did those not at such risk. For instance, 74% of those with breast cancer used any supplement, whereas 46% of those without breast cancer did; 26% of those with high blood pressure and cholesterol concentrations took vitamin E supplements compared with ≈16% of those without these risk factors; and 76% of those with osteoporosis took calcium supplements, compared with only 25% of those without osteoporosis. Lyle et al (25), in 1998, also found that more women (24%) with a history of cancer used vitamin E supplements (containing > 30 IU) than did those who had not had cancer (7%). Of the women enrolled in the Women's Health Initiative, 44% took multivitamin supplements regularly before entry into the study: 53% took vitamin E, 53% took vitamin C, and 52% took calcium.

Regular use of nutritional supplements by female physicians increased with age (Table 5), although we found no significant differences by ethnicity or region (Table 4). Others have shown that supplement use among registered nurses also increased with age and was most common in California (20). Data from the first and second National Health and Nutrition Examination

TABLE 5
Regular use of any supplement by US female physicians by age and ethnicity[1]

Ethnicity	Age	
	30–54 y	Age 55–70 y
	%	
All	45.3 ± 1.1 [1338]	66.1 ± 1.6 [854][2]
Hispanic	44.5 ± 5.4 [49]	59.3 ± 9.6 [29]
Black	41.0 ± 5.3 [45]	62.7 ± 12.6 [12]
Other	40.8 ± 6.2 [36]	88.8 ± 5.5 [22][2]
Asian	40.4 ± 2.7 [180]	71.1 ± 3.6 [157][3]
White	46.4 ± 1.2 [1028]	64.7 ± 1.9 [634][3]

[1] $\bar{x}$ ± SE; *n* in brackets. "Regular use" is defined as consumption ≥ 5 d/wk.
[2,3] Significantly different from those aged 30–54 y (chi-square test): [2] $P \leq 0.001$, [3] $P \leq 0.0001$.

Surveys (NHANES I and II) showed that more whites than blacks used supplements and that usage increased in both groups with age (11, 12). Similarly, the 1987 National Health Interview Survey (NHIS) found that 60% of white women compared with 45% of black women consumed any type of supplement during the previous year (18). Only 15% of white women aged 17–24 y reported daily supplement use, whereas 40% of those aged 55–64 y reported daily supplement use; the respective percentages in age-matched black women were 12% and 21%. Female physicians who were widowed (57%) used vitamins more regularly than did those who were single or never married (41%) (Table 4). NHIS data reported in 1989 showed that 40% of those widowed, separated, or divorced used supplements compared with 34% of those who never married, suggesting that supplement use is not merely a function of age, but also of single living (17).

In most surveys, supplement use increased as years of education and income increased (12, 25); we found no association between personal income and supplement use and an inverse relation between household income and supplement use. However, in our population, both years of education and income were uniformly well above national averages.

Of the nondrinking female physicians, 52% (compared with 45% of drinkers) used supplements regularly, although regular supplement use by drinkers increased with increasing alcohol intake. Supplement use was also higher in NHIS participants with lesser alcohol consumption (18). Unlike others' findings (18, 25), the small number of female physicians who currently smoked (n = 176) were somewhat more likely than were those who had never smoked to regularly use supplements.

Seven categories of supplement use were assessed in our study. About 47% of the physicians used any supplement regularly (≥5 d/wk); this level is comparable with most of the data from other mail surveys (Table 2) but higher than that from national surveys with in-home interviews (Table 1). Regular multivitamin use was reported by 36% of our mail-surveyed physicians, which is similar to the percentage (38%) of regular supplement users among mail-surveyed female nurses (20). Of the mail-surveyed dietitians (96% of whom were women), 28% reported daily use of supplements (21). NHANES I and II and the NHIS (in-house interviews) reported that ≈20% of women used multivitamins regularly. Of the 113 women participating in the intensive in-person interview portion of the Women's Health Initiative cohort, 27% used multivitamins daily, whereas 44% of the entire cohort self-reported daily multivitamin use (24). This difference may have been due to overreporting of supplement use by the women when the interviews were not face-to-face, differences between the wording of the questions, or the nature of the response formats; further research is warranted.

Vitamin A (retinol) and β-carotene supplements were consumed regularly by ≈12% of female physicians; in contrast, ≤4% of those represented in the surveys listed in Tables 1 and 2 reported consuming vitamin A supplements regularly. Vitamin C supplements were taken regularly by 19% of the female physicians. About 23% of the nurses (20) and 26% of the dietitians (21) took vitamin C regularly. NHANES I and II and the NHIS reported that <10% of women took vitamin C supplements; the other surveys listed in Tables 1 and 2 reported that 20–53% of the women surveyed took vitamin C regularly.

Vitamin E supplements were used by 16% of the female physicians compared with 15% of the nurses in 1981 (20). The most recent data from the subset of the Women's Health Initiative cohort and the Western Washington Survey (published in 1998 and 1999, respectively) reported that 23% and 29% of the participants took vitamin E supplements. Others published that 9% of mothers of school-age children (in 1990; 23), 10% of white study participants (in 1998; 25), and 12% of a cohort with a mean age of 48 y (1990; 22) took vitamin E supplements. Major national surveys reported that <5% of those surveyed took a daily single supplement containing vitamin E (11, 18).

TABLE 6
Regular antioxidant use by female physicians with (+) and without (−) risk factors for coronary heart disease (CHD)[1]

	CHD+	CHD−
	%	
Family history of MI, angina, or bypass	— [1503]	— [2775]
Multiantioxidant	15.7 ± 1.2 [241]	11.8 ± 0.8 [354][2]
Vitamin A	13.1 ± 1.1 [229]	10.8 ± 0.7 [352]
Vitamin C	20.1 ± 1.3 [363]	17.9 ± 0.9 [567]
Vitamin E	20.5 ± 1.3 [367]	14.3 ± 0.8 [498][3]
BP > 140 or history of high BP	— [577]	— [3701]
Multiantioxidant	19.9 ± 2.4 [109]	12.3 ± 0.7 [486][2]
Vitamin A	17.5 ± 2.2 [101]	10.9 ± 0.6 [480][2]
Vitamin C	25.1 ± 2.4 [161]	18.0 ± 0.8 [769][2]
Vitamin E	27.1 ± 2.5 [171]	15.2 ± 0.7 [694][3]
Diabetes	— [84]	— [4194]
Multiantioxidant	18.9 ± 6.2 [18]	12.9 ± 0.6 [577]
Vitamin A	12.0 ± 4.4 [15]	11.5 ± 0.6 [566]
Vitamin C	19.9 ± 5.4 [25]	18.5 ± 0.7 [905]
Vitamin E	15.2 ± 4.7 [21]	16.2 ± 0.7 [844]
Current smoker	— [176]	— [3943]
Multiantioxidant	24.7 ± 4.5 [40]	12.3 ± 0.6 [529][2]
Vitamin A	22.7 ± 4.4 [40]	11.0 ± 0.6 [516][2]
Vitamin C	24.2 ± 4.4 [48]	18.3 ± 0.7 [842]
Vitamin E	27.7 ± 4.3 [55]	15.7 ± 0.7 [774][2]
Cholesterol > 6.2 mmol/L	— [231]	— [2748]
Multiantioxidant	15.7 ± 3.0 [40]	14.6 ± 0.9 [417]
Vitamin A	17.9 ± 3.2 [44]	12.3 ± 0.8 [395]
Vitamin C	23.4 ± 3.6 [59]	20.3 ± 0.9 [631]
Vitamin E	26.5 ± 3.8 [69]	17.2 ± 0.9 [575][4]

[1] $\bar{x}$ ± SE; *n* in brackets. "Regular use" is defined as consumption ≥5 d/wk. MI, myocardial infarction; BP, blood pressure.
[2–4] Significantly different from CHD+ (chi-square test): [2] $P \leq 0.01$, [3] $P \leq 0.0001$, [4] $P \leq 0.05$.

TABLE 7
Regular use of vitamin-mineral supplements by female physicians with (+) and without (−) selected chronic medical conditions[1]

	Condition+	Condition−
Breast cancer	— [136]	— [4142]
Any supplement	74.3 ± 4.8 [99]	46.9 ± 1.0 [2126][2]
Multivitamin-mineral	57.2 ± 5.5 [72]	35.1 ± 0.9 [1494][3]
Multiantioxidant	19.7 ± 4.2 [28]	12.8 ± 0.7 [567]
Vitamin A	20.9 ± 4.7 [25]	11.3 ± 0.6 [556][4]
Vitamin C	37.4 ± 5.8 [45]	18.3 ± 0.7 [885][5]
Vitamin E	36.5 ± 5.3 [53]	15.8 ± 0.7 [812][3]
Calcium	50.6 ± 5.6 [66]	25.5 ± 0.8 [1228][2]
Iron	9.9 ± 3.5 [10]	10.5 ± 0.6 [377]
Cervical, uterine, or ovarian cancer	— [72]	— [4206]
Any supplement	51.6 ± 8.2 [40]	47.3 ± 1.0 [2185]
Multivitamin-mineral	37.4 ± 8.1 [29]	35.5 ± 0.9 [1537]
Multiantioxidant	16.8 ± 5.5 [12]	12.9 ± 0.6 [583]
Vitamin A	15.7 ± 5.6 [11]	11.4 ± 0.6 [570]
Vitamin C	22.3 ± 6.2 [17]	18.5 ± 0.7 [913]
Vitamin E	26.3 ± 6.6 [20]	16.0 ± 0.7 [845]
Calcium	25.7 ± 6.6 [23]	26.0 ± 0.8 [1271]
Iron	7.8 ± 3.7 [7]	10.5 ± 0.6 [380]
Colorectal or skin cancer	— [151]	— [4127]
Any supplement	51.8 ± 5.7 [88]	47.2 ± 1.0 [2137]
Multivitamin-mineral	31.7 ± 5.2 [55]	35.4 ± 0.4 [1511]
Multiantioxidant	15.5 ± 4.4 [23]	12.9 ± 0.6 [572]
Vitamin A	12.0 ± 3.3 [23]	11.5 ± 0.6 [558]
Vitamin C	18.7 ± 3.8 [42]	18.5 ± 0.7 [888]
Vitamin E	25.2 ± 5.2 [44]	15.9 ± 0.7 [821]
Calcium	37.1 ± 5.9 [57]	25.7 ± 0.8 [1237]
Iron	6.2 ± 2.6 [8]	10.6 ± 0.6 [379]
Diabetes	— [84]	— [4194]
Any supplement	54.0 ± 7.9 [52]	47.2 ± 1.0 [2173]
Multivitamin-mineral	42.0 ± 7.8 [37]	35.4 ± 0.9 [1529]
Multiantioxidant	18.9 ± 6.2 [18]	12.9 ± 0.6 [577]
Vitamin A	12.0 ± 4.4 [15]	11.5 ± 0.6 [566]
Vitamin C	19.9 ± 5.4 [25]	18.5 ± 0.7 [905]
Vitamin E	15.2 ± 4.7 [21]	16.2 ± 0.7 [844]
Calcium	25.8 ± 6.8 [25]	25.9 ± 0.8 [1269]
Iron	8.0 ± 3.6 [7]	10.5 ± 0.6 [380]
Osteoporosis	— [106]	— [4172]
Calcium	76.1 ± 5.3 [70]	25.4 ± 0.8 [1224][2]

[1] $\bar{x}$ ± SE; *n* in brackets. "Regular use" is defined as consumption ≥ 5 d/wk.
[2–5] Significantly different from condition+ (chi-square test): [2] $P \leq 0.0001$, [3] $P \leq 0.001$, [4] $P \leq 0.05$, [5] $P \leq 0.01$.

Iron supplements were taken by 10.5% of the female physicians. In contrast, only 3.3% of those surveyed in NHANES I, 4% of the dietitians (21), and 3% of those represented in the Seven Western States survey (22) took iron supplements. However, the average age of our female physicians was 42 y, whereas that of those represented in the Seven Western States survey was 48 y. Therefore, these differences in iron supplement use may have resulted because more of the female physicians than of the women in the other surveys were menstruating. We found that fewer postmenopausal than premenopausal physicians took iron supplements (data not shown).

Twenty-six percent of the female physicians regularly took calcium supplements. In contrast, only 2% of the general population surveyed in NHANES III (32), 3% of the dietitians (21), and <10% of those represented in the other national surveys took calcium supplements. However, in the surveys that involved women aged >45 y, the percentages of those taking calcium supplements was higher— 63% in the study by Medeiros et al in 1989 (22).

Multiantioxidant use was not included in any of the studies cited in Tables 1 and 2. Nearly 40% of the female physicians took either a multiantioxidant or single supplements of the major antioxidants vitamins C and E—a much higher proportion than is seen in the general population. We did not include the percentage of physicians who took supplements of vitamin A (β-carotene) because the participants were not asked about their use of this antioxidant.

In conclusion, about two-thirds of the female physicians took supplements; almost one-half did so regularly. The most commonly used supplement was a multivitamin-mineral supplement (35%), in agreement with data from other mail surveys of health care professionals over the past 20 y. The female physicians were especially likely to take supplements containing folic acid (multivitamin), antioxidants, and calcium. Use of these supplements may reflect the physicians' exposure to data from clinical studies indicating the beneficial effects of these nutrients in the prevention of diseases, such as osteoporosis, that are more prevalent in women. Additionally, 35% of the female physicians reported a known personal or family history of CHD. The fact that folic acid and antioxidant consumption are thought to reduce the risk of CHD risk and that physicians are particularly aware of the link between the family history of and personal risks of heart disease (6) may also explain the physicians' use of both antioxidants and folic acid–containing supplements.

Variations in supplement use among the female physicians seem to reflect variations in disease risk factors, particularly in those with cardiovascular disease risk factors and osteoporosis. More than 75% of female physicians with osteoporosis took calcium supplements, compared with 25% of those who did not have osteoporosis. Note that, overall, 38% of the entire cohort took calcium supplements (26% regularly), which is much higher than the most recent data from NHANES III, which showed that ≈2% of women took calcium during the past month.

Some believe that physicians routinely disparage vitamin use, but the present data suggest that >50% of all female physicians surveyed and 66% of those aged ≥55 y use vitamin supplements. It appears that female physicians are aware of the research suggesting that consumption of certain micronutrient supplements may reduce chronic disease risk, and therefore choose to take these nutritional supplements at rates similar to, and sometimes higher than, those of women in the general population.

TABLE 8
Regular use of vitamin-mineral supplements by female physicians who are self-described vegetarians[1]

Supplement	Vegetarian (*n* = 342)	Not vegetarian (*n* = 3284)
	%	
Any supplement	59.9 ± 3.3 [210]	46.3 ± 1.0 [1960][2]
Multivatimin-mineral	48.0 ± 3.4 [159]	34.5 ± 1.0 [1371][2]
Multiantioxidant	21.1 ± 2.8 [70]	12.2 ± 0.7 [508][3]
Vitamin A	20.7 ± 2.9 [67]	10.6 ± 0.6 [494][2]
Vitamin C	32.0 ± 3.2 [104]	17.3 ± 0.7 [798][4]
Vitamin E	28.4 ± 3.0 [99]	15.0 ± 0.7 [738][4]
Calcium	31.6 ± 3.3 [108]	25.6 ± 0.9 [1158]
Iron	18.4 ± 2.9 [50]	9.9 ± 0.6 [329][3]

[1] $\bar{x}$ ± SE; *n* in brackets. "Regular use" is defined as consumption ≥ 5 d/wk.
[2–4] Significantly different from vegetarians (chi-square test): [2] $P \leq 0.001$, [3] $P \leq 0.01$, [4] $P \leq 0.0001$.

REFERENCES

1. Weber P, Bendich A, Machlin LJ. Vitamin E and human health: rationale for determining recommended intake levels. Nutrition 1997;13:450–60.
2. Carr AC, Frei B. Toward a new recommended dietary allowance for vitamin C based on antioxidant and health effects in humans. Am J Clin Nutr 1999;69:1086–107.
3. Stephens NG, Parsons A, Schofield PM, Kelly F, Cheeseman K, Mitchinson MJ. Randomized controlled trial of vitamin E in patients with coronary disease: Cambridge Heart Antioxidant Study. Lancet 1996;347:781–6.
4. Dawson-Hughes B. Vitamin D and calcium: recommended intake for bone health. Osteoporos Int 1998;8(suppl):S30–4.
5. The Alpha-Tocopherol, Beta Carotene Cancer Prevention Study Group. The effect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. N Engl J Med 1994;330:1029–35.
6. Patterson RE, Krystal AR, Neuhouser ML. Vitamin supplements and cancer risk: epidemiologic research and recommendations. In: Bendich A, Deckelbaum R, eds. Primary and secondary preventive nutrition. Totowa, NJ: Humana Press (in press).
7. Tribble D, Frank E. Dietary antioxidants and the diseases of aging. West J Med 1994;161:605–12.
8. Levine M, Conry-Cantilena C, Wang Y, et al. Vitamin C pharmacokinetics in healthy volunteers: evidence for a recommended dietary allowance. Proc Natl Acad Sci U S A 1996;93:3704–9.
9. Young VR. Evidence for a recommended dietary allowance for vitamin C from pharmacokinetics: a comment and analysis. Proc Natl Acad Sci U S A 1996;93:14344–8.
10. Frank E, Kunovich-Frieze T. Physicians' prevention counseling behaviors: current status and future directions. Prev Med 1995;24: 543–5.
11. Block G, Cox C, Madan SJ, Schreiber GB, Licitra L, Melia N. Vitamins supplement use, by demographic characteristics. Am J Epidemiol 1988;127:297–309.
12. Koplan JP, Annest JL, Layde PM, Rubin GL. Nutrients intake and supplementation in the United States (NHANES II). Am J Public Health 1986;76:287–9.
13. Looker AC, Sempos CT, Johnson C, Yetley EA. Vitamin-mineral supplement use: association with dietary intake and iron status of adults. J Am Diet Assoc 1988;88:808–14.
14. Block G, Sinha R, Gridley G. Collection of dietary-supplement data and implications for analysis. Am J Clin Nutr 1994;59(suppl): 232S–9S.
15. Stewart ML, McDonald JT, Levy AS, Schucker RE, Henderson DP. Vitamin/mineral supplement use: a telephone survey of adults in the United States. J Am Diet Assoc 1985;85:1585–90.
16. Bender MM, Levy AS, Schucker RE, Yetley EA. Trends in prevalence and magnitude of vitamin and mineral supplement usage and correlation with health status. J Am Diet Assoc 1992;92:1096–101.
17. Moss AJ, Levy AS, Kim I, Park YK. Use of vitamin and mineral supplements in the United States: current users, types of products and nutrients. Hyattsville, MD: National Center for Health Statistics, 1989:1–19.
18. Subar AF, Block G. Use of vitamin and mineral supplements: demographics and amounts of nutrients consumed. The 1987 Health Interview Survey. Am J Epidemiol 1990;13:1091–101.
19. Slesinski MJ, Subar AF, Kahle LL. Trends in use of vitamin and mineral supplements in the United States: the 1987 and 1992 National Health Interview Surveys. J Am Diet Assoc 1995;95:921–3.
20. Willett W, Sampson L, Bain C, et al. Vitamin supplement use among registered nurses. Am J Clin Nutr 1981;34:1121–5.
21. Worthington-Roberts B, Breskin M. Supplementation patterns of Washington state dietitians. J Am Diet Assoc 1984;84:795–800.
22. Medeiros DM, Bock MA, Oritz M, et al. Vitamin and mineral supplementation practices of adults in seven western states. J Am Diet Assoc 1990;90:383–8.
23. Merkel JM, Crockett SJ, Mullis R. Vitamin and mineral supplement use by women with school-age children. J Am Diet Assoc 1990; 90:426–42.
24. Patterson RE, Kristal AR, Tinker LF, Carter RA, Bolton MP, Agurs-Collins T. Measurement characteristics of the Women's Health Initiative food frequency questionnaire. Ann Epidemiol 1999;9:178–87.
25. Lyle BJ, Mares-Perlman JA, Klein BEK, et al. Serum carotenoids and tocopherols and incidence of age-related nuclear cataract. Am J Clin Nutr 1999;69:272–7.
26. Patterson RE, Neuhouser ML, White E, Kristal AR, Potter JD. Measurement error from assessing use of vitamin supplements at one point in time. Epidemiology 1998;9:567–9.
27. Frank E. The Women Physicians' Health Study: background, objectives, and methods. J Am Med Womens Assoc 1995;50:64–6.
28. Frank E, Rothenburg R, Brown WV, Maibach H. Basic demographics and professional characteristics of US women physicians. Woman Physician 1997;166:179–84.
29. Frank E, Brogan DJ, Mokdad AH, Simoes EJ, Kahn HS, Greenburg RS. Health related behaviors of U.S. women physicians versus other U.S. women. Arch Intern Med 1998;158:342–8.
30. White R, Seymour J, Frank E. Prevalence and effects of vegetarianism in U.S. women physicians. J Am Diet Assoc 1999;99:595–7.
31. Sauberlich HE, Machlin LJ, eds. Beyond deficiency: new views on the function and health effects of vitamins. New York: New York Academy of Sciences, 1992.
32. Bendich A, Leader S, Muhuri P. Supplemental calcium for the prevention of hip fracture: potential health-economic benefits. Clin Ther 1999;216:1058–72.